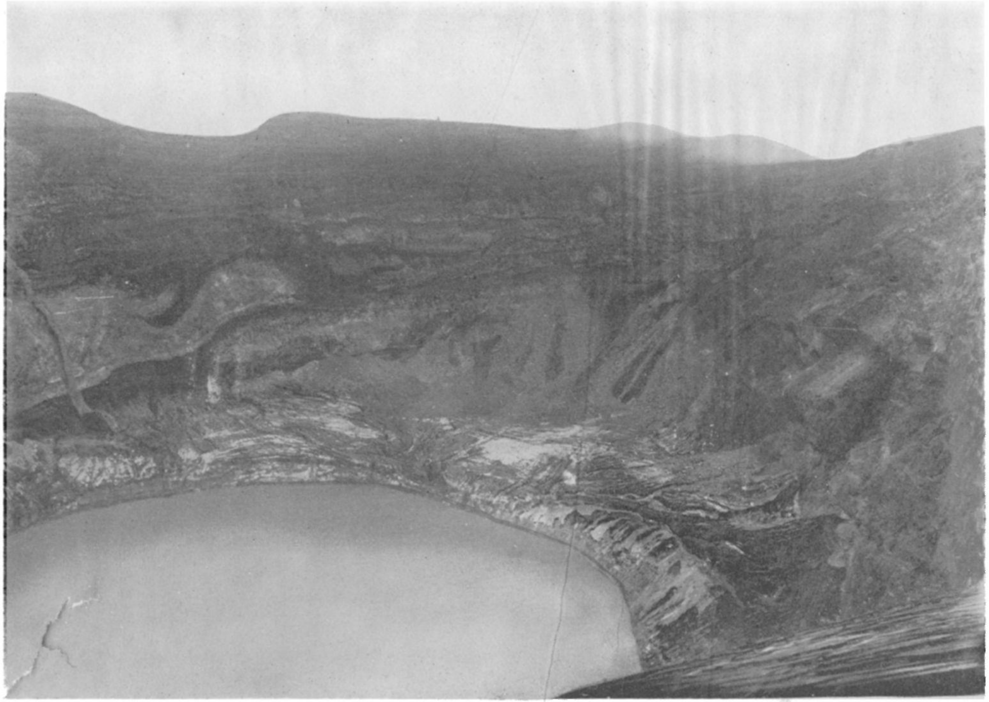

SOUFRIERE, ST. VINCENT, WEST INDIES, SHOWING ITS CRATERAL LAKE.

[*Frontispiece.*

THE RIDDLE OF THE EARTH

By

APPIAN WAY

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FOREWORD

DURING the past year, 1924, it may have struck many people besides the writer that there was something unaccountably wrong with the weather over almost the whole of the Northern Hemisphere. Particularly was it the case in Western Europe where, if blessed by the Gulf Stream, the countries contiguous to it and Great Britain and Ireland in particular seem to be the dumping ground of all the rain and wind and general depression which the Gulf Stream seems to be able to collect. There was not only no sunshine fit to mention ; there were thunderstorms, fitful, sudden and dangerous throughout the year ; there was a tremendous hurricane during the first days of September, and the year 1924, dishonoured and cordially disliked, went out on the wings of a series of astonishing gales and floods.

The weather is a subject we all discuss. Even a stiff and canny Scotsman will wax eloquent on the question of the weather. Nor is it surprising since vast interests are wrapped up in the incidence of weather conditions. The harvest may be made or marred by the weather. Crops may never ripen if there is no stable summer weather. Livestock fails to thrive, languishes and gets diseased. Shipping and transport are affected. Public arrangements are upset. Not only, indeed, are agriculturists and producers of almost all commodities hit hard by incessant bad weather but the whole life of the community is thrown out of gear. As these words are being penned great areas in the Thames valley and elsewhere are flooded, and the actual loss in damage and destruction is enormous. Any question of meteorological conditions is one therefore which affects one and all of us intimately, directly and indirectly, our healths and our pockets.

In regard to the weather another observation is to be made. The commercial centre of the world and the seat of the greatest population amongst the white races is on either side of the Atlantic Ocean. Most of the world's cereals, meat, cotton and manufactures as yet come from either side of that vast circumfluous ocean's lands, and likewise that same region is cursed with the most eccentric, inconsistent, and unreliable weather conditions in the world. The United States and Canada experience greater extremes of heat waves or cold blasts than is usually the case in the British Islands, but on the other hand the weather is more consistently unreliable in the British Isles owing probably to the action of the Gulf Stream which has a habit of conducting one disturbance after another to these shores.

In spite of the importance of the subject the astounding fact remains that we do not seem to know anything really about the causes which affect the weather. Expensive weather bureaus and meteorological offices are maintained at the public expense, and they tell us that a disturbance is approaching or an anti-cyclone is on the way; they station agents in the Azores, at St. John's, Newfoundland, and elsewhere to report; sometimes they are right, often they are not. None of these experts appear to possess the slightest knowledge of the initial causes which operate to produce sudden and violent disturbances of the elements. Presumably they are aware that both air and water are condensed gases, but why air and sea exist is one of those matters people take for granted, although the moon which is a planet has neither. There is reason to suppose that the oceans and seas are gradually increasing in volume. Where is the water coming from? Nay, where has it all come from? We are expected to believe that the lands on the earth's surface have been thrown up at different periods from a molten interior; but it can scarcely be maintained that all the water of all the oceans and seas and lakes and rivers was also ejected in this manner, and that they have provided us with our needs ever since that day some millions of years ago? Where did all the water come from that was loosened over most of Europe between December 26th, 1924, and January 3rd, 1925, a series of astounding gales in which millions of tons of water were flung down upon millions of square miles of land and sea?

The meteorologists do not tell us that. They probably do not think it is their concern, but if they knew more about the causes of weather disturbance it would perhaps enable them to assist the peoples on either side of the Atlantic instead of the Meteorological office being as at present more a poor joke than anything else.

The vast gale or series of gales which began with no premonitory warnings on December 26th, 1924, and continued until January 3rd, 1925, indicated that somehow there had been introduced into our atmosphere vast quantities of hydrogen and oxygen which had condensed. Those who have studied meteors and are aware of their constituent qualities were supplied with a solution to the mystery when it appeared that in Rome on about December 26th, a great meteor had been observed flashing past the earth. It was estimated to have been as big as the moon and very nearly struck the earth. British astronomers remained quite unaffected by this announcement. Greenwich Observatory, when interviewed, doubted the accuracy of the alleged size of the meteor, and apparently regarded any collision with the stoic indifference of superior knowledge. American astronomers, who are concentrating on the study of meteors and comets, took it seriously and the American Press discussed the great meteor. It was probably a celestial object discovered by Dr. Baade, of Bergedorf, at the end of October, 1924, and pronounced by Greenwich to be a " minor planet," which Dr. Crommelin discovered complacently had an orbit that brought it nearer to the sun than any planet except perhaps Eros. (*Morning Post*, October 31st, 1924.) Dr. Crommelin may be right, but a strange round cometary object implies something coming towards us, and while the meteor will probably go nearer to the sun than Eros it apparently came near to putting a great part of this earth out of business for a considerable time. As it was it left behind as a New Year's gift some of its gases which were attracted into our atmosphere. They condensed and hence the storms and gales.

In a word, weather phenomena is involved with other natural phenomena. Gales, hurricanes, typhoons, landslides, volcanic eruptions, earthquakes, meteors and comets are all co-related.

It is surprising, in view of the interest millions of educated people take to-day in every form of science, that these great subjects such as volcanoes and earthquakes as well as comets and meteors are allowed to be placed on a shelf. To those who have studied these matters it is inexplicable that otherwise well-informed people accept without question the archaic ideas produced by supposed authorities such as that a volcano is thrown up from the earth's interior, and an eruption is the escape of molten rock through a " fault " in the crust ; that an earthquake is caused by a contraction of the earth's crust due to the slowly cooling incandescent mass below ; and that comets and meteors are to all intents and purposes harmless. Such was the teaching in the smug Victorian period and it still survives to-day in regard to such subjects, much as in Herodotus' time any one who said the world was round was likely enough to be boiled alive, or as in the time of the Popes prior to the fifteenth century any one who dared assert there was land on the other side of the Atlantic stood in danger of excommunication. Archaic doctrines long survive the intelligence of the contemporaneous masses, but sooner or later they must go.

Generally the accepted experts in each branch of learning stick to their last and leave severely alone other preserves. Weather experts take no account of volcanic eruptions or earthquakes, although both produce heavy rains and cold weather. Volcanoes in turn are very closely concerned with earthquakes and both are inseparable from meteor falls and the meteor streams which intersect the earth's orbit periodically. Meteors are the disintegrated fragments of comets and these in their turn have a very direct bearing upon natural catastrophes both great and small, and are the original causes, there is good reason to believe, of the vast geological changes which have resulted in the continents and islands, oceans and seas, as they are to-day.

It is time there were a revision of all these forms of natural science.

In this little work, which does not pretend to be exhaustive, or indeed more than suggestive, the writer attempts to indicate an entirely new theory, or, indeed, a return to the very old and classic beliefs on the subject of the creation of the lands and seas upon this planet. The key to the true understanding of these matters is contained in the volcano. A volcano, it is suggested, is in reality the residue of another world, the deposit of a meteor, which contains all the earth's ingredients. Volcanoes follow a general law, or, rather, meteors obeying an impulse which brings them towards the earth from the direction of the Magnetic Pole when they strike the earth, fall along certain isodynamic lines. Where the lines of volcanoes stretch in any given direction, from, say, south-east to north-west, or from east to west, or from north-north-east to south-south-west, as at present is the direction of the Ecliptic Pole, so at one time that part of the earth was the position of the then North Pole. By a series of huge dumpings or deposits, by means of tremendous impacts, was age after age built up, and by the linear direction of volcanoes extinct or alive can a prior period of the world's history be identified.

Such is the theory advanced. It is shown how these meteor deposits, volcanoes, gradually cool and die out like a fire unless they are renovated by other meteor impacts which may strengthen and increase them as is the case with many volcanoes. An active volcano, it is pointed out, attracts the wandering meteor, and hence an active volcano in a state of eruption is always a danger to all within its vicinity. Yet all these have their uses. Without volcanoes to draw them in we should not attract so many meteors, and the earth would languish and gradually lose its air and sea.

We require a new and untrammelled attitude upon these questions of great purport, and in placing this little book in the hands of the public the author, conscious of its defects, hopes nevertheless that it may be received on its merits and the arguments he advances be weighed dispassionately without prejudice. In that event he will have little cause to fear the result.

Thanks are due to Mr. Charles E. Elmhurst, of the Museum, York, Hon. Sec. of the Yorkshire Philosophical Society, and to that body, as also to Mr. John Murray, of Albemarle Street, for according permission to use photographs taken by the late Dr. Tempest Anderson, F.R.S., and for his series of "Volcanic Studies in Many Lands," published by Messrs. Murray in 1917. The late Dr. Anderson's photographs of volcanoes which he took in all parts of the world remain the most valuable record of pictorial volcanic art in existence.

APPIAN WAY.

March, 1925.

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CHAPTER I

THE WEATHER AND EARTHQUAKES

ATMOSPHERIC DISTURBANCES

FEW persons realise perhaps how absolutely dependent are all forms of life upon the incidence of weather. Give us too much air and we experience raging storms and hurricanes which destroy the crops and cause misery and destitution to millions. Give us too little air and animals and plants languish or die, drought is experienced with its attendant ills, and unless fresh air cleanses the fœtid atmosphere there results suffocation and loss of life. Therefore the problem of the cause of our atmosphere, its eccentricities and peculiarities, the production of great storms or blazing heat waves and the apparent lack of any systematic explanation of the reason of depressions or anti-cyclones is one of paramount importance.

2. We know that air is composed of various gases, mainly nitrogen and oxygen, and that if we are taken out of our element we die. What we do not know is where this air comes from, forming as it does a sort of cushion between the world and outer space. It must be evident that our air or atmosphere requires frequent renovation and

recruitment. We cannot suppose that during the myriads of years before and since individual existence first began on this earth the atmosphere has remained a stable force, for the merest reflection must show it to be an impossibility, and it must be renewed on many occasions. Indeed, everybody who gives the question any thought must recognise that the incidence of great gales and tempests, when the elements wage furious war together, presupposes the introduction of new atmospheric forces in some manner as yet unaccounted for by any method of scientific research.

3. The idea that rain is caused by the absorption of moisture drawn from the oceans and seas attracted by the sun's rays is one lacking scientific proof. If such were the case the natural inference would be that rain clouds would be regularly formed and would fall incessantly like a waterfall, and on such a theory the tropics, where the heat and consequently any attraction is greatest, should experience the most consistent and continuous rainfall, whereas we know that except for the rainy season the tropical and sub-tropical belts of the earth are rainless as a general rule and in some parts, as in Egypt and Peru, without rain always. It is evident that another reason must be sought to explain the incidence of weather conditions. Meteorologists teach that solar radiation is directly or indirectly responsible for most of our weather variations, because they assume that this radiation, together with the earth's rotation, is the

cause of practically the whole of our atmospheric circulation and the phenomena of cyclones and anti-cyclones, winds and storms, resulting therefrom. It does not explain the facts at all, for the sun's rays are constant and unvarying except in so far as big sunspots may temporarily affect radiation, but there are periods when during a maximum of sunspots the weather is steady and settled, and there are other occasions when sunspots are at a minimum and the weather has been marked by a succession of great storms. Whatever effect sunspots may or may not exert upon the sun's radiation it cannot justly be said that they go the first step towards solving the problem.

3A. It must appear, with due respect, that meteorologists are chasing a chimera. The weather, reflecting atmospheric conditions, is, it can be shown, only a part of meteorology closely interconnected with earthquakes and volcanic eruptions. That is to say, when we have solved the true causes of both earthquakes and volcanic eruptions, which are in their turn the effect of certain unknown causes, the mystery of the earth's atmosphere, storms, rain and depressions will be solved also.

RECENT ATMOSPHERIC DISTURBANCES

4. The year 1924 is very appropriate as the starting point of an inquiry into these causes, for world weather in the northern temperate and subtropical belts of latitude had been extremely eccentric since the beginning of September, 1923,

cold, wet, marked by violent gales and atmospheric disturbances, and with a summer notably deficient in settled weather, warmth and sunshine. The position in the British Isles was such that the crops had in most parts been a failure and farmers found themselves in a precarious financial position in consequence.

4A. To understand the weather of 1924 it is advisable to revert first to September, 1923, when at noon, September 1st, occurred the Tokio earthquake which synchronised with cold and wet weather, although prior to that it had been normal. Perhaps it would be permissible to go so far back as the Chile earthquake of November, 1922, a very disastrous series of shocks, accompanied by a tidal wave 180 feet high, which picked up big sailing ships and in some instances hurled them inland a quarter of a mile. In the British Isles the wet weather was by some experts attributed to the presence of the largest sunspot since March of that year. It may be more justly credited (or debited !) to the Chile earthquake, for these events, as will be shown, cause a considerable disturbance to the atmosphere and take some time to enable conditions to resume the normal. A succession of earthquakes results in continued depressions, although so far as the British Isles are concerned the affected localities must be considered. The Gulf Stream, which acts as a centre of distribution for atmospheric disturbances, collects these, and with the prevailing south-west winds, brings these depressions across the Atlantic to the British shores; but the system is spread wider than the Atlantic alone, and British farmers cannot remain indifferent to earthquakes in the Cordilleras any more than in Japan, for the British Isles as the dumping ground of much of the after-effects, is like old Æolus, who kept the winds in a cave on his island.

5. In addition to the Chile earthquake other major atmospheric disturbances have to be noted. Some time about August, 1922, a new volcanic island made its appearance suddenly off Saigon, in French Cochin-China. In July, 1923, the master of the steamship *Jacox* reported it to the hydrographer's office in Washington. It was dark in colour, with steep cliffs, about 100 feet in height, and between two and three miles in length. The sea (said Reuter's report) was washing away loose material and repeated explosions were heard at intervals of about a minute, causing huge waves. In March, 1924, the crater was reported to be active. It is certain that a new island of such magnitude could not have been created without exerting considerable atmospheric effects over a wide region.

6. A comparatively minor occurrence was the Amalfi "landslip," so called, at the end of March, 1924. It covered a narrow track but its destruction was marked, for several villages above Amalfi perched on the mountain side were said to have been destroyed, and one village was partially

buried under an enormous rock, while the famous terrace of the Cappucini Convento Hotel at Amalfi was swept away. Furthermore, this " landslip " occurred suddenly, was accompanied by a tidal wave which devastated the coast over a length of a quarter of a mile, and Stromboli, to the south, burst into eruption. It caused considerable damage to property, and over 100 lives were lost, mainly by being struck by rocks.

GLAMORGAN " TORNADO " COMPARED WITH AMALFI " LANDSLIP "

7. It is evident that a landslide would not account for such incidents as a tidal wave and a volcano bursting into eruption, and later reports attributed the catastrophe to an earthquake, for violent atmospheric disturbance, tremendous rain, an air vacuum, and volcanic activity are all associated with the phenomenon of an earthquake. This Amalfi affair bears a close resemblance to what is known as the Glamorgan Tornado of November 1st, 1913. This " Tornado " was vividly described by a correspondent of the *Daily Telegraph*, as caused by " a terrifying blue ball of flame." Mr. Clement Edwards, then Member of Parliament for East Glamorgan, notified the following features which marked its progress :—

(*a*) Nowhere was its track more than 200 yards wide.

(*b*) Nothing within that area escaped damage.

(*c*) Persons saw a " ball of flame shooting as though from a gun or rolling with a terrible swiftness."

(*d*) It was accompanied by a great tempest and fire.

(*e*) Also a waterspout or cloudburst which swamped the area and prevented the villages in its course from being consumed by flames.

(*f*) Over 200 houses were destroyed and thousands were considerably damaged.

(*g*) Its " weird and uncanny freaks " caused roofs to be torn off buildings, a corrugated iron garage was lifted bodily from one field and thrown violently into another, heavy furniture and fences were picked up by the gale and carried long distances, hay-ricks were carried through the air for over a mile and big trees were uprooted and moved considerable distances.

(*h*) The tornado coincided with a serious colliery explosion in the region which caused the death of many miners.

8. In their general features these two events, the Amalfi landslide and the Glamorgan tornado correspond. The tremendous gale over a narrow track, the cloudburst, the suddenness, reveal the same outward effects. If the Stromboli eruption were related to the Amalfi affair there is reason to believe that certain destructive gases were a feature of the phenomenon and were attracted to the volcano. There is no such visible conductor in the nevertheless ancient volcanic area of South

Wales, but such gases were probably the cause of the colliery explosion. I shall return to this question in due course in relation to earthquakes and volcanic eruptions. All that need be remarked in passing is that meteorologists were quite unable to produce any cogent reasons for either the Amalfi landslide or the Glamorgan tornado.

THE ATLANTIC HURRICANE OF AUGUST, 1924

9. The summer months of 1924 were marked by a continuity of severe thunderstorms usually brief, but accompanied by thunderbolts, and heavily charged with electricity and cloudbursts. There were also reported a number of earthquakes in Britain, notably in Derbyshire and on the west coast of Scotland. August was on its worst behaviour throughout. In that month an earthquake was reported in Turkestan, followed by vast rain, causing enormous floods over a great area, and the end of the month synchronised with an Atlantic hurricane, between 20° and 60° longitude west of Greenwich. This hurricane was connected with a considerable earthquake shock along the west coast of Iceland accompanied by a tidal wave. The tidal wave struck the *Arabic* in mid-ocean in three gigantic waves and almost carried the liner of 16,786 tons on her beam ends. She took three minutes before righting. The force of the gale also struck the Leeward Islands, resulting in much loss of life and considerable damage to property. In Montserrat many were killed and injured,

valuable machinery and buildings were wrecked, and all crops destroyed. In Tortola, Nevis, Antigua and St. Kitts casualties and damage were heavy and many sailing ships were wrecked or reported missing.

9A. The explanation of this storm, according to the officials of the Weather Bureau at Washington, was that the cyclone followed unusually hot weather and created a large vacuum. But why should hot weather create a vacuum? An anticyclone is not an abnormal condition and does not create a vacuum, for if this were so why are not the tropics continually devastated by tremendous storms created by these vacui? The abnormal condition is the cyclone.

" A tropical revolving storm " was a further explanation offered of this occurrence which excited great interest in New York as one after another great liners came limping into dock, their decks littered with *débris*.

Cause of a Storm's Vortex

" The mystery of the origin of these revolving storms has for years been the subject of keen investigation," said an official of the Marine Division of the Meteorological Office in an interview. " The *Arabic* got right into the vortex of the revolving storm," which was described as " an intense whirl in the atmosphere in which there is usually a calm centre." Outside this vortex and blowing towards it " there is a belt of rushing winds," and more storms of this nature occur during the months of August and September than in any other part of the year. While these facts may be true they do not carry us to any great distance and indeed are mere observations on the event and not on the cause. They do not attempt to explain the reason of this sudden vacuum or vortex towards which the belt of rushing winds concentrate. They signally fail to account for a tidal wave which is a very different thing to a stormy sea. In a word, they carry us nowhere.

10. We know that the air follows the same general principle as the sea, that is, it consists of waves and moves in currents. Now, when a tidal wave is set up in the ocean or sea, it is evident that somewhere and by some means a considerable displacement of water is the immediate cause, just as a stone thrown into a pond sets up a miniature tidal wave. A vacuum has been created in the waters, and these thrown violently aside form a tidal wave. When we discover sometimes a tidal wave of vast magnitude, such as during the Tokio earthquake of September, 1923, when the repercussion was felt on the shores of California, 4,750 miles distant, clearly enough a very great vacuum has been created and consequently a colossal displacement of the waters.

10A. The same principle must apply to the air vacuum. When, in the hurricane under discussion, we discover a very great displacement of the air the inference is that something has created that vacuum and furthermore that what caused the tidal wave also created the air vortex. The further logical assumption is that to create a tidal wave some *solid body* struck the ocean. What solid body could be hurled through space, capable of causing an earthquake, an air vacuum, a hurricane, and a tidal wave ?

11. The explanation I shall propose is that the original movement was a meteor impact. Meteors may be of any size, large or small, and it will probably be discovered in due course that all these strange phenomena, the earthquakes in Chile and Tokio and Turkestan, the volcanic island off Saigon, the landslide of Amalfi, the Glamorgan tornado, and numerous other earthquakes, volcanic eruptions, waterspouts, landslides, and even colliery disasters are attributable to this one source ; and that one of their effects is to create atmospheric disturbance over wide areas, mainly owing to the gases which accompany them, these including hydrogen, nitrogen and hydro-carbons.

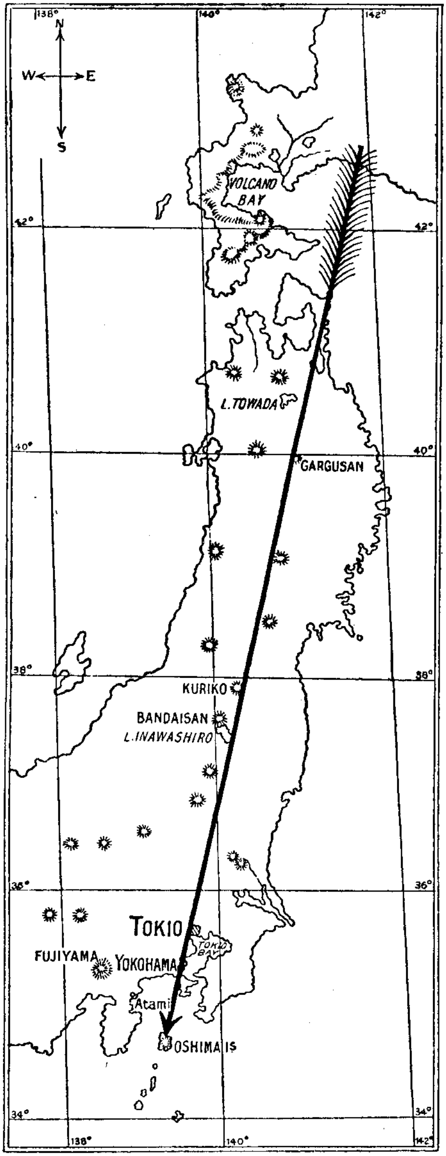
THE TOKIO EARTHQUAKE, 1923

12. The Tokio earthquake occurred suddenly, the only warning being an intense oppressiveness beforehand. It came in the form of a dozen vertical four-inch wave movements, and these shocks continued intermittently for a week. A conflagration simultaneously followed the earthquake in both Tokio and Yokohama, which broke out, not in one spot, but everywhere. In the

former city 350,000 houses were destroyed mainly by fire, and 130,000 casualties resulted. The conflagration was attributed to gases released from the earth. The next affliction was a tremendous downpour of rain which lasted for several days and deluged the areas. An enormous tidal wave destroyed many coast towns and four tidal waves crossed the Pacific Ocean, struck the California coast 4,750 miles distant from the point of impact, and broke small boats from their bearings. Islands off Yokohama were submerged and the island of Oshima, it was said, sank into the sea and reappeared larger than before with a volcano in full eruption. Fujiyama, the Japanese volcano to the west of Tokio, it is interesting to note, was unaffected.

12A. The theory of the Central Observatory of Tokio was that the earthquake originated in a landslip undersea, half way between the Atami hot springs and Oshima Island. Mr. Shaw, the British seismologist, was also of opinion that the earthquake had its origin under the sea off the coast of Japan where the strata slopes deeply down into the Pacific to the Tuscacora Deep, thus giving a formation "peculiarly favourable to earthquakes."

12B. This theory of a landslide at a considerable depth under the ocean fails to account for the circumstances in almost every particular. It does not explain, assuming for the moment that the earthquake was due to a submarine landslide :



VOLCANIC MAP OF JAPAN.

The arrow shows the N. and S. direction of the Earthquake of 1923, striking Tokio, Yokohama and Oshima Island in turn. Tokio lies 60 miles due N.E. from the point of impact of the Meteor. The string of volcanic cones and Meteoric lakes will be noted along the arrow.

(*a*) Why the atmosphere was sultry and oppressive beforehand at Tokio lying inland ;

(*b*) Why the full force of the quake shook Tokio first, seventy miles north from the alleged centre of disturbance ;

(*c*) Why it created a conflagration and a subsequent downpour in Tokio ;

(*d*) Why the force of the quake was not felt at its alleged focus ;

(*e*) Why such a huge landslide not only did not absorb the Japanese islands but re-created Oshima with a volcano, and some accounts add other new islands—also with volcanic cones ;

(*f*) Why it could cause such an immense tidal wave that its effects were felt nearly 5,000 miles away.

12C. A further objection could be raised of itself sufficient to destroy this theory, namely, that the earthquake followed a trajectory from north to south. It began at Tokio and ended in the Japan Sea. This fact is very important because the accepted theory of earthquakes, as of volcanic eruptions, is that there is some fracture or fault in the earth's crust, that it adjusts itself to correct the fracture, and hence the earthquake. In such circumstances the effects might be expected to be felt not within a definite and specified track (in this case and as almost invariably) from north to south, but as radiating in all directions from a common centre. Again, we can instance the common example of a stone striking and breaking a pane of glass. It causes fissures and fractures in all directions. The Tokio earthquake followed a line of meridian from the north and its area or track was sharply circumscribed along a linear course.

METEORS AND ATMOSPHERIC DISTURBANCES

13. The particular characteristics of this earthquake are that it signalised its advent by a sultriness, created a vacuum, was accompanied by fire and electrical or magnetic disturbances, produced an enormous quantity of rain and also a tidal wave. In a word, it displaced both the atmosphere and the sea. It will be seen again that in its main phenomena it corresponds with the " revolving storm " of the Atlantic Hurricane which occurred almost exactly one year later. The main difference, it may be premised, was not in its character but in the locality, the missile in the one case falling in the sea of Japan in proximity to a densely-populated country, in the other falling in mid-ocean where only its after-effects were felt, unless there happened to be a ship or ships at the actual point of contact, when such ships would be added to the list of missing vessels reported at Lloyd's of which no trace is ever found. The meteor as the originating cause of the Atlantic Hurricane—if such it were—also seems to have followed a track from north to south, and to have actually fallen at some point north of the Leeward Islands.

14. The Amalfi landslide, comparatively insignificant as it was, belonged undoubtedly to the same genus of phenomena, and the tidal wave infers its impact with the sea. Had it been witnessed from the bridge of a passing ship it would probably have been entered in the ship's log as a waterspout.

15. As it may be objected by the reader that had these various catastrophes been caused by falling meteors they would have been seen, it should be said that they fall so swiftly the eye cannot fix them except at night at a distance away when they show as a long and brilliant stream of light. In the daylight they are invisible to the naked eye and are only heralded by vapours in advance. They fall as a rule tangentially, and in their passage, nearing the earth, are the cause of earthquakes. They appear to follow along certain lines of longitude and are apparently attracted to the volcanic belts of the earth. There is a very close relationship between earthquakes and volcanic eruptions, and the best way to arrive at some understanding of these terrible and threatening visitations is to examine the locale, structure, actions and produce of volcanoes.

In all the cases cited, and as will be seen in all records of earthquakes and volcanic eruptions, atmospheric conditions have been considerably affected. A disturbance, whether it be termed an earthquake, a landslide, a tornado or a hurricane, bears a close family resemblance differing only in regard to the magnitude of the event or to the locality wherein it may occur. The result in any case is a displacement of the atmosphere, which seeks to readjust itself and so causes depressions of varying magnitude that may affect the weather over enormous areas and prolonged periods.

CHAPTER II

VOLCANIC ACTIVITY IN THE NORTH

VOLCANIC BELTS

THE Atlantic hurricane, Tokio earthquake, Chile earthquake, Amalfi landslip, and the Glamorgan tornado all took place in the so-called earthquake or volcanic belt. As to the latter disaster, South Wales, Somerset, Devon and Cornwall were at one time the centre of a violent volcanic area, although the volcano in the vicinity has been destroyed (91, 92, 92A, 108, 108A). At the same time, the hot thermal waters of Bath and Bristol reveal an existing volcanic influence which appears to be yet a potential source of danger. The Turkestan earthquake, in the neighbourhood of the Caspian and Caucasus, occurred in an active area to which the oil regions owe their origin.

17. It is true that earthquakes can and do occur without a volcano in the vicinity, or without a volcano near by being thrown into violent paroxysms. The former case was instanced by the Lisbon earthquake of 1755 (19A, 87B), although it would appear that simultaneously a meteor passing from north to south buried itself in the Atlas

Mountains and fell upon two Moorish villages, which of course were totally destroyed. The event in question may be connected with Kattlagia, one of the Icelandic volcanoes which in that year suffered a severe paroxysmal eruption, accompanied by electrical phenomena and poison gases whereby men and cattle were killed. The latter case is manifested in the Tokio earthquake of September, 1923, for Fujiyama, in the vicinity, remained unaffected, although on the other hand volcanoes burning furiously arose in Oshima Island and in its neighbourhood.

18. Earthquakes of magnitude occur now mainly north of the equator with two pronounced exceptions, *e.g.*, along the chain of the vast Cordilleras in South America and in the neighbourhood of the Malay Archipelago. None the less the Southern Hemisphere is very considerably of volcanic origin, as we use the term, for the various archipelagi forming Polynesia, Melanesia, Hawaii, the Sandwich Islands, and the Marshall Archipelago are nothing but a collection of intense volcanic mountains of which perhaps the most extraordinary are Tahiti with Little Tahiti, in reality two vast volcanic dumps, the larger having had its original crater knocked to pieces by later cones on its summit and with many others on its flanks, all betokening a distant period of extreme violent and prolonged activity.

18A. Early in 1895 a disastrous hurricane was reported from the Fiji Islands, in which shipping suffered severely, many lives were lost and solid buildings, including churches, were destroyed. Apparently connected with this was an extraordinary volcanic outburst which devastated with lava half the large island of Ambrym in the New Hebrides. A crater was built up from 800 to 1,700 feet in height and three miles in circumference at its orifice. This sudden eruption destroyed almost the total population of the island, then numbering 8,000 persons. New Zealand continually shows her active volcanic existence, and in September, 1924, Reuter's Agency reported an eruption of the " Devil's Frying Pan," a flat surface on the open side of the crater close to the famous Waimangu geyser in North Island. This " Devil's Frying Pan " seems to be a part of an older crater, and a fissure occurred of 150 feet, not a major event. The interesting feature is that this locality had displayed activity for some little time past, and the water of Lake Rotomahana had been steadily rising for the previous two months. On the other hand, the many islands of volcanic origin around Africa, such as Ascension, St. Helena, Tristan d'Acunha, the Seychelles, Mauritius and Réunion, seem to be either dead or showing no signs of activity. I shall duly distinguish between the remarkable liveliness of the Northern Hemisphere as compared with the Southern, and advance a reason for the greater activity of the former.

BELTS OF LONGITUDE

19. Professor Hale, the American meteorologist, has drawn attention to the fact that earthquakes, which he attributes to meteor collisions with the earth, usually occur within certain defined areas and along lines of longitude rather than latitude. He says :—

> The fall of the bodies seems to be governed by certain isodynamic lines of magnetism . . . these bodies fall upon certain belts of the earth as they do upon the Sun and Jupiter . . . and the belts do not appear to follow lines of latitude but seem to be governed by polar or magnetic conditions.

19A. When they strike the earth, continues Hale, they fall tangentially (slantwise) and generally from the direction of the Magnetic Pole. This tangential direction is evinced, if the connection were established, in a meteor drawn to Kattlagia in Iceland, failing to strike it and falling, partly in Lisbon Harbour and partly in the Atlas Mountains, almost along the same meridian of longitude due north to south. Great although the distance be in point of mileage, some 40 degrees or 2,400 miles, the time occupied in passing from Iceland to the Atlas Mountains would only be a few moments.

19B. The particular lines of longitude embracing this earthquake or volcanic belt can be partially defined by certain strings or lines of volcanic centres from north to south, but into this system Malayan cones only enter for another reason to be presently defined. These linear ranges are as follows :—

(*a*) Jan Mayen Island, Hebrides, West Ireland, Lisbon, Atlas Mountains.

(*b*) Jan Mayen Island, Iceland, Madeira and Canary Islands.

(*c*) Greenland (East), Iceland (Hecla), Azores and Cape Verde Islands.

(*d*) Greenland, the Outer Antilles, Venezuela, Bolivia and Chile.

(*e*) Florida, the Bahama Islands, Jamaica, Ecuador and Peru.

(*f*) Texas and Mexico.

(*g*) California.

(*h*) Alaska, Honolulu (Hawaii) and perhaps North Island, New Zealand.

(*i*) Aleutian Islands, Marshall Islands, New Hebrides.

(*j*) Kurile Islands, Japan, Philippines and Molucca Group.

(*k*) Hainan, Saigon (Cochin-China), Sumatra and Java.

(*l*) Calcutta, Andaman and Nicobar Islands.

(*m*) Nova Zembla, Turkestan, Caspian and Caucasus.

(*n*) Black Sea, Turkey and the Ægean Sea.

(*o*) Spitzbergen, Bohemia, Vesuvius, Stromboli and Etna.

19C. The above are the main lines of longitude along which earthquakes seem to proceed in the Northern Hemisphere, although there is a predisposition often seen of an earthquake disturbance to move rather from north-east towards the south-west than from due north to due south, which supports Hale's contention of a polar or magnetic source. This system, if it may be so termed, applies in so far as polar conditions go to the Northern Hemisphere, where, on Hale's theory, we should find not only considerable land surfaces, the residue of meteor deposits, but also evidence of great seismic and volcanic force. And so we do. Spitzbergen, Nova Zembla, and the islands between them towards the North Pole show torn and tattered lands; the north and north-west coasts of Scandinavia with their deep rocky fiords, like the east coast of Greenland, have been shattered by some tremendous agency in the past, while Jan Mayen Island, between them, has a big volcano; Finland has been battered by another great disturbance; further south the Shetland and Orkney Islands, the Outer and Inner Hebrides, and the north and western coasts of Scotland and Ireland reveal similar conditions of a terrible series of volcanic bombardments at some distant period. Iceland possesses at least eleven or twelve great volcanoes which are intermittently active, and in fact this remarkable island with its huge cones is entirely of volcanic formation with every mountain a volcano. Jan Mayen Island was in eruption in April, 1818, and periodically since, and the coast of Greenland possesses two, three, and some reports say four, considerable volcanoes.

ECCENTRICITY IN NORTHERN TEMPERATURES

19D. This extraordinary dispersion of volcanic energy is not only wholly absent in the South Polar regions, but the atmospheric and climatic conditions are there much more equable. The Southern Temperate Zone completes an almost exact and regular circuit along the latitude of 60 degrees south, but the northern is extremely eccentric. It rises and falls in waves, descending in the region of James Bay (Canada) to 7 degrees below the mean, whereas by a then steady incline it includes Iceland and onwards to a place north of the North Cape, some 15 degrees above the mean level, stretching nearly 10 degrees into the Arctic regions. Thus in the north there are extremes of variation amounting to 22 degrees. The variation from the level of 60 degrees to 75 degrees north is explained by the Gulf Stream, of which there is no equivalent in the south. How and why the Gulf Stream takes the course it does from the Gulf of Mexico is a problem which science has not yet resolved, but it flows steadily, with branches or canals flowing from it, towards the magnetic north. It is not surprising, however, in view of this contest between two climatic zones, that the conditions do not make for atmospheric calm, and that when the atmosphere is continually disturbed by the phenomena termed earthquakes the regions washed by the Gulf Stream become the vortex of the conflicting elements.

20. Put very simply, the circumstances suggest that any major disturbance of the atmosphere within the North Atlantic region and probably even in the Northern Pacific usually leads to cold, wet weather sooner or later in the British Isles. If no earthquakes were reported over a period the probability is that the British Isles and the Atlantic would enjoy warm and fine weather. Every disturbance which takes place is or should be a sign to meteorologists to prepare for depressions.

One of the greatest and most reliable signs of all are volcanic eruptions, for reasons which I shall proceed to outline.

CHAPTER III

VOLCANIC SYSTEMS

CLIMAX OF ERUPTION SUDDEN

FROM the very earliest days volcanic mountains became the objects of intense religious devotion, as conveyed in such myths as those of Mt. Atlas, Prometheus, and Mt. Culhuacan (of the Aztecs), and any one who reads the Book of Exodus with care will acknowledge that Moses when he led the children of Israel to the burning mountain conducted them to a volcano, where they witnessed the presence of God as fire, otherwise as that most awe-inspiring spectacle, an eruption.

21A. These sometimes begin abruptly without previous preparatory warning, but more usually an eruption is heralded by mild explosions and smoke emanating from the crater, which then either gradually increases in intensity until at length with dramatic suddenness after a lull there occurs a vast explosion as of an impact, when the mountain may be blown literally in two or razed to the ground, as happened to Krakatoa in Java in 1883. Sometimes an eruption preceded by such premonitory warnings proves abortive, dies down, and no climax occurs (26).

21B. The Mt. Pelée eruption of May, 1902, is a

MT. PELEE, MARTINIQUE, JULY, 1902.

STROMBOLI, CRATER SEEN FROM ABOVE.

[*To face p.* 26.

good example of the former crisis-bringing type. It began to break into mild eruption some six weeks before the crisis, gradually augmenting in strength and volume, but with periods of comparative calm, until at length a deafening explosion was heard at eight o'clock one morning; the mountain exhibited a huge fissure and was said to have been blown in two; a great tidal wave of boiling water swept the bay, destroyed much shipping, and enormous rocks were hurled for miles out to sea. St. Pierre, the capital of Martinique, lies south-south-west of Mt. Pelée, a dangerous site for human habitation, and every single living creature in the city of over 20,000 inhabitants was killed outright, apparently by shock. Further south *along the same meridian of longitude* 61.10 west, Soufrière, the volcano of St. Vincent, 160 miles distant, had shown intermittent activity at the same time as Pelée, and simultaneously with the crisis burst out into a violent convulsion, evidently in sympathy with the latter. (See Fig., p. 100.)

21C. The interest in Mt. Pelée lies in the apparent fact that a long period of inactivity was broken by a steady but increasing sign of vitality, reaching, until a day or two before the crisis, considerable volume in loud explosions, expulsion of scoriæ, dust and ashes, and quantities of smoke, together with a certain amount of lava, which does not generally occur until the crisis has been reached. This lull dissembled the fears of the people of St. Pierre, and in fact excursions were arranged to visit the neighbourhood of the crater, while the Professor of Geology at the University in St. Pierre wrote articles for the local journals telling the public they had nothing to fear. A few days later not a soul was left alive ! The explanation of the Martinique disaster is that a volcano may be set into paroxysmal activity by contact with meteoric gases (which gases may drift into the atmosphere without the body necessarily striking the earth), and that such an absorption of gaseous fluids leads to explosions and a minor eruption such as both Pelée and Soufrière displayed until the crisis. When a volcano is in eruption it apparently exerts magnetic attraction to any meteoric body in the vicinity of the earth, and on this occasion Pelée attracted a meteor of some size which caused the deafening explosion, fissure in the mountain's sides, tidal wave of boiling water, and shock which destroyed life within the immediate vicinity along the line from north to south.

Volcanoes Situated on or near Seas

22. It is observable that active volcanoes are almost invariably found on islands or in lands bordering on the sea, and, indeed, except for an alleged volcano in the Tian Shan Mountains of Asia, no inland continental active volcano is known. The volcanic lines follow, as necessarily they must, the earthquake belt, which means

that most particularly we see a system stretching from Spitzbergen, through Bohemia, to Vesuvius, Etna, Stromboli, and all their group (19B (*o*)), embracing everything westward until we come to the Kuriles, Japan, Philippines and Moluccas in the west (19B (*j*)), that is to say, the Atlantic and Pacific regions. Here mainly, excepting for the Malay States, the Southern Pacific and New Zealand, can it be said that active volcanoes reside, thus leaving out of account the whole of the remainder of Asia, European Russia, Africa and Australia.

THE VOLCANIC KEY TO GEOLOGICAL AGES

23. At the same time there are indications of a change in system in some comparatively late period of geological time. The earlier system seems to have taken a direction from east to west, and from south-east to north-west (a system earlier yet), laying down regions once extremely volcanic but now long since for the most part disintegrated and denuded. One may trace the outline of this ancient system in Southern Europe from the Caucasus to the Carpathians, the Styrian Mountains and Tyrol, the Pennine Alps (where in Valais and Vivarais are a line of over 200 extinct cones), all in alignment with the Pyrenees and Cantabrians in Spain. There were once no fewer than fifteen volcanoes in Catalonia alone, and in the Auvergne, a considerable range of mainly trachyte

mountains, from north to south, cutting across an earlier range from Lozère to the Limousin Mountains, covering 156 square miles, is a chain of over seventy volcanic cones on an earlier strata mainly of granite. This difference in linear direction presupposes a subsequent alteration in the direction of the Pole and overlapping by later systems.

24. It is possible, indeed, that with further knowledge of the causes of the laying-down of volcanoes we may be enabled to reconstruct the earth much more correctly in its various geological ages than Suess and others have hitherto been successful in accomplishing. If it should be established that great accretions of land surfaces have been deposited by various vast appulsions of cometary bodies as Sir Isaac Newton premised as possible, and if such bodies approach the earth from the direction of the Magnetic Pole, the linear arrangements of mountain ranges would follow the north-to-south direction from that portion of the earth's surface *at that time forming the North Pole.* Astronomers are well aware that the Poles have shifted very considerably, and have been inverted from geological age to geological age, and I venture the suggestion tentatively that almost its earliest or initial stage lay probably in the Pacific Ocean some way south of Easter Island. If this were the case the Polynesian islands, laid down almost invariably in a direction pointing from the south-east to the north-west, mark the earliest

lands on the earth's surface,* and coincident with these were the New Zealand Ridge, New Hebrides, Solomon Islands, New Guinea, Sumatra, and the western coast of North America from the Sierra Madre to Alaska. In such a division the Himalayas, the Persian Mountains, the Caucasus, Carpathians and Italian Apennines should be included as part of the original scheme. But when this occurred the southern parts of the Pacific lay within the region of the then North Pole, and of course Europe lay in the Southern Hemisphere, assuming always that these vast impacts of meteors came from the direction of the present Magnetic Pole. The earth's axis adjusted itself to the resultant changes.

24A. Again, we may conjecture a further change, dependent upon the fresh masses of land surfaces projected in divers latitudes. The earth's axis swung further round, and in consequence a new linear formation was deposited, and we discover among others the Caroline Islands, Java, some of the Tibetan Mountains, the Eastern parts of the Hindu Kush and Pamirs, the Kohi-Baba of Afghanistan, the Styrian Alps and the Tyrol, the Pennine Alps and some of the Iberian ranges ; as well as the Venezuelan Mountains and the Mexican volcanoes. Once more it shifted, the Pole moving towards the north-west to a spot beyond perhaps the Gobi Desert, along the line of Khuigan and Stanovoi Mountains, with Kamchatka very near the then Pole. A great many ranges were laid down in this alignment and lands created of considerable importance, including the Chilian Andes, Scandinavia, the Vosges, Taurus Mountains in Asiatic Turkey, the Erz-Gebirge in Saxony, the Atlas Range in North-West Africa, many of the mountains stretching down the east coast of Africa, the Alleghany Mountains of North America, the Cambrians and many of the Highlands of Scotland, Wales, Cornwall, and South-west Ireland. It should be understood that this is but indicative and not in any sense a complete or comprehensive list.

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* From Pitcairn Island to the Paumotu or Low Archipelago Tahiti, Cook Islands, Samoa, and, further north, Hawaii. There are, however, various degrees, not one movement, but at least three, over great periods.

THE PRESENT METEORIC SYSTEM

25. We now reach the present meteoric system, which in its general features appears to be directed from north or north-east to south or south-west. The Pennines of England appear to be related to it, the Ecuador and Peruvian Andes, the Auvergne Mountains of France straddling an earlier range, and in Italy we discover a line bisecting the Apennines, from Mount Amiata, *viâ* Monte Cimini, the Campagna, Phlegrean Fields, thence with Ischia on the one side and Vesuvius on the other the line descends to the several volcanic Lipari Islands with the giant Etna and her children at the base. The other lines related to this active section have been described previously, including

all the Atlantic islands and those in the Caribbean Sea. A century ago Moreau de Jonnés, a geologist of standing, pointed out that these volcanic chains usually follow the meridians from north to south. We have the visual evidence of this before our eyes and records prove what physical geography confirms that for a considerable age the volcanic or seismic belt has followed the linears from the direction of the present Magnetic or the Ecliptic North Poles. It accounts for the prevalence of meteoric falls within the regions north of the Equator. These are matters to which students of meteorology should direct their careful attention, for they have a vital bearing upon the world at the present time and in the near future. The effect of it is that the Northern Hemisphere lying within the volcanic belt remains pre-eminently in the danger zone and in the event of any great catastrophe may be expected to feel its full and awful effects until such time as by a transfer of weight, due to some vast and tremendous accretion of materia, the earth's axis will shift to a fresh direction and once again, as has occurred during the great geological changes, another part of the earth's surface will be enveloped within the regions of the Poles.

CHAPTER IV

VOLCANIC ERUPTIONS AND THEIR LESSONS

A VOLCANO IN ACTIVE ERUPTION

A VOLCANIC eruption in process is a majestic and awe-inspiring sight. Repeated loud detonations proceed from the crater, varying from sounds like the rattling of machine guns to the impressive booming of the heaviest artillery. Smoke and flames emerge from the orifice while dust and ashes are projected high in the heavens. Often after a few paroxysmal pangs the eruption subsides with the ejection of some lava and is known as a minor eruption. Sometimes after the preliminary warnings it quietens down without expelling lava, and is termed an abortive eruption. The same volcano is capable of abortive, minor, or major eruptions.

27. In the case of a major eruption, after usually preliminary rumblings and signs of activity the crisis appears suddenly and unexpectedly. The atmosphere becomes sultry and oppressive, which causes apprehension to man, beast and bird. Then an earthquake of considerable force shakes the mountain to its foundations and frequently vast fissures or rents appear in its flank in a vertical

line. A terrific blast is heard and through the rent lava flows in a white liquid form which quickly congeals. Often such an eruption produces a new crater and from this and its flanks the gases, steam, and other gases or fluids in their rapid escape project upwards vertically the loose accumulated matters and the fragments of the more solid rocks through which they have forced a passage. Authorities on vulcanism explain all this phenomena as originating in the bowels of the earth, caused in the first place by some fault in the earth's crust whereby the incandescent materials supposed to comprise the earth's core escape and force their way upwards. The earthquakes are caused on their theory by the efforts of the lava, swelling on all sides from the increasing elasticity of the auriform fluids it contains to force a passage through the superincumbent rocks.* It is a theory insupportable in every single particular —as will appear on closer investigation.

DISPERSION OF VOLCANIC PARTICLES

28. The violence and rapid projection of these fragmentary rocks and the larger rocks retained in or near the orifice gradually reduces those which fall again into the crater to a state of such tenuity that they are eventually carried upwards into the air and remain suspended for a considerable period on occasions in the heated clouds of aqueous and gaseous vapour which the volcano discharges in

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* Scrope on " Volcanoes."

prodigious volume from the aperture. So fine does this volcanic dust become that it has been known to remain suspended in the air for upwards of a year, and probably a great deal, if not all the soil which overlies the earlier strata, is the disintegrated particles of volcanic dust distributed by this means. It should be noted that the strength, character, and velocity of eruptions vary very considerably not only in comparison with one another but even with themselves. Vesuvius has expelled scoriæ to a height of about 4,000 feet, and Cotopaxi has sent up fragments more than 6,000 feet above its crater, situate nearly 19,000 feet above sea level. To understand the violence of the ejection of which a volcano is capable this same Cotopaxi has been said to project a mass of rock of 1,000 cubic feet a distance of nearly ten miles. The scoriæ expelled by the forces within a volcano in eruption are all more or less broken, commuted, or pulverised by the mutual friction they exert on one another in the air.

ERRATIC PERIODS OF ACTIVITY IN VOLCANOES

29. Volcanoes are for the most part singularly erratic in their periods—as also in their intensity. A few are in a state of ever-existent activity on a minor scale such as Stromboli, whose chimney is for ever smoking. Vesuvius, Etna, and the Icelandic mountains are periodically ablaze. Why Stromboli should remain in a state of mild activity and yet other incomparably greater volcanoes in

its proximity only intermittently, is perhaps due to its situation and the form of its crater. Stromboli has been in ceaseless eruption so far as is known for nearly 2,000 years at least and perhaps for much longer. Mount Vesuvius, Etna, and the Icelandic group should be placed in the list as the most regular of the intermittent class, but even with these occur quiescent intervals of very unequal duration, sometimes even of centuries. Vesuvius, for example, between 1139 and 1306—for 167 years—closed up and lay quiescent, a lake and chestnut groves occupied the site of the crater, and as is at present the case with so many of the extinct craters of the Auvergne, Etna, the Vivarais, etc., the superficial scoriæ having become decomposed and turned into very fertile soil, vineyards and other fruits of the earth were grown, forests grew up and decayed, when suddenly a great eruption took place and the erstwhile cultivated lands became a yawning and burning abyss. After this there was another lull for 325 years, which, taking a corresponding period in English history from now, would throw us back to Queen Elizabeth's reign, when again a similar scene was enacted. From the records it would seem that during the last 100 years, and especially during the last twenty-five years, there has been much more volcanic activity in Etna and Vesuvius than in mediæval times.

29A. Long intervals occur also in the various Atlantic isles, such as the Azores, Canaries, Cape

Verde, Caribbean Islands, and the more southern isles, such as St. Helena, Tristan d'Acunha, etc. The same applies, perhaps, to Sumatra, Java (which has lost the volcano of Krakatoa), the Moluccas, Kamchatka, and the Pacific generally. On the other hand, we do not uncommonly hear of terrific eruptions occasionally breaking out from mountains not previously suspected of being of a volcanic nature or of which accounts of former catastrophes existed but as tradition. Scrope, for instance, mentions Soufrière, St. Vincent, which erupted in 1812 after having been quiescent it was said from 1119. Popocatepetl, also, the great volcano in Mexico, has just burst into eruption in February, 1925 (as these pages are being passed for press), after a sleep of 400 years, and the whole district in the immediate vicinity has been deserted.

30. A volcano in major eruption produces many effects among which should be mentioned heavy rain, acids and gases, various lava rocks, fissures, new craters on old, parasitic or subsidiary craters, small volcanoes within the region, islands, hot springs, lakes sometimes of naphtha, carbonised and fossilised wood. It will be convenient to examine these in detail, beginning with rain.

RAIN ACCOMPANYING ERUPTIONS

31. A volcano as it bursts into eruption produces or attracts a vast column of heated clouds and

smoke ascending to a considerable height in the heavens, heavily charged with electricity and many gases, where it spreads out on a similar principle to a waterspout or like a gigantic umbrella. The column or pillar emerging from the orifice, owing to its density, gives an impression of solidity and emits tremendous quantities of electrical phenomena. It appears to consist of masses of globular clouds of vapour pressing each upon the one below and urged incessantly upwards by repeated explosions. At a considerable height, determined by its density to the atmosphere and the action of heat, the column dilates horizontally in dark, turbid, circular clouds. Forked and branched lightnings vent continually from different facets, but especially from its fringe. Its increase soon obscures the light of day from the surrounding region below, and sand and ashes combine to produce an atmosphere of deep and depressing gloom.

31A. These threatening demonstrations are accompanied by violent thunderstorms and rain. The vapours which have risen from the orifice or gathered about it condense rapidly, and the rain falls in prodigious quantities producing torrents on the sides and base of the volcano, as well as over a considerable area beyond, and these, mixing with fallen ashes, sand, clay and scoriæ rush in deluges of liquid mud towards the lower parts, covering them with considerable deposits of volcanic alluvium, capable of most fertile crops.

32. The lava or alluvium contain various acids,

salts and liquefied gases such as sulphuretted hydrogen, sulphuric and hydrochloric acids and carbon dioxide, sodium sulphate, sodium chloride, ammonium chloride, carbonate of soda, iron and copper chlorides and sulphides of arsenic ; soda, potash, lime and iron are constant ingredients in lava, as also ammonia and bitumen ; boracic acid is another ingredient, and naphtha is discovered often in large quantities. These substances react on one another, and certain of them mixed with the oxygen of the air cause intense rain and generate electricity.

LAVAS—THEIR CONSTRUCTION

33. The lava of an eruption is a conglomerate rock expelled in a liquid form from the volcano. It is composed of all kinds of minerals including both the older as well as the later formations of rocks.

34. At the moment of emission lava appears as a substance in liquid form at a brilliant white heat, although curiously enough in proportion it radiates comparatively little heat. Its liquidity shortly after contact with the air does not exceed that of honey, and it requires pressure with a stick or iron rod to penetrate the surface. It consolidates almost immediately and emits a considerable quantity of vapour commonly of an acrid or sulphurous character which escapes from the cracks and crevices caused by the splitting of the outer crust. The whiteness of the lava turns rapidly to red and thence to black.

35. The very small quantity of heat radiated by lava indicates that it must owe its liquidity to some other agent than heat (caloric) alone. The lighter lavas are composed mainly of felspar or of an aggregation of crystals, and even scoriform dust is crystallised, which is an indication that although liquefied it has not been completely fused, for if a portion of such a lava is reduced to complete fusion by artificial heat it hardens into a glass without traces of lithoidal or crystalline structure. A certain element or elements must therefore play a part in the construction of lava rocks, and this peculiarity is an argument against the theory of geologists that the vast internal heat of the earth seeks an outlet and expels certain rocks in lava form, as in such case the lava might be expected to reveal complete fusion and hence no lithoidal or crystalline structure. As the heat in the interior of a volcano in eruption is far beyond any artificial caloric the inference must be that some of the rocks expelled in lava form have not been completely fused, and that therefore so far from being in a liquid state in the bowels of the earth they were subjected to sudden and violent treatment, liquefied by explosive and other gases, and rapidly expelled through the orifice of the volcano without having remained there sufficiently long to be thoroughly fused.

35A. This is a very important factor in determining the origin of an eruption, for there are two classes of lava recognised (with several subdivisions), the one felspathic and the other basaltic. The same volcano in the same eruption sometimes expels both classes of lava rock, and it will be seen in due course that the violence of the eruption, which in turn depends upon the extraneous gases introduced, is the main determining factor.

36. Before considering this aspect more closely it would be well to give a concise idea of the lavas, for their external structure must vary according to their mineral composition and the treatment to which they have been subjected. Light lavas such as felspath are glassy and filamentous. The basaltic or heavier lavas are more solid, compact and dense with fewer or smaller pores. Basaltic lavas nevertheless often produce very perfect crystals of augite or leucite as have been found at Stromboli, Etna (Monte Rossi), Monte Albano, etc. The specific gravity of felspar to augite, hornblende, and titaniferous iron, is the average proportion of 4 to 5. Of these two classes we have the following sub-divisions.

36A. *Felspar.*

(*a*) Rocks of felspar with occasional quartz crystals and more frequently mica, are denominated trachyte.

(*b*) Common trachyte displays generally a coarse granitoidal grain combined with harshness of texture, very porous, and with irregular composition of crystals. When the crystals lie in parallel planes giving a slaty structure the rock is called clinkstone. The Auvergne Mountains (23), though built on a strata of granite in most parts, rest on basalt in some places and on freshwater marls and clays. This great range, with a length of eighty miles and an average width of six miles, contains clinkstone often 500 to 600 feet in depth.

(*c*) Trachyte when fine and compact is called trachytic porphyry ; when joined to a scaly structure, compact felspar ; when the crystals are so composed as to give a resinous or glassy texture it is termed pitchstone or obsidian.

36B. *Basalt.*

(*d*) Where augite or titaniferous iron or both occur in considerable proportion it is termed basalt. In this rock olivine usually makes its appearance. The felspar is sometimes replaced by leucite and common augite by hornblende (hemi-prismatic augite) and in very rare instances by hauyne.

(*e*) Those basalts where the grain is extremely coarse, appearing to consist mainly of visible crystals of augite, are termed dolerite. When hornblende occurs in this mixture it is named greenstone.

(*f*) Finer grained compounds are termed basalt, and when the structure is slaty it is named basaltic clinkstone.

37. Volcanoes may be and often are based upon the most primitive rocks, and the rocks through which a fissure may be forced can be of primary,

secondary or tertiary date. The volcanic cones of the Auvergne for instance are situated upon primary rocks and contain fragments of granite, gneiss, and mica schist, as well as limestone, as found in the freshwater basin of the Limagne. Vesuvius sometimes ejects granite or gneiss, but more frequently the lava is of secondary limestone, and occasionally of tertiary sandstone or marls. In the Auvergne, at Mont Dore, Cantal and Mezen, basalt, trachyte and clinkstone seem to alternate in layers. In the Grande and Petit Puy de Dome basalt has constantly succeeded trachyte from the same vents. In Monte Cimini (Italy) in the Campi Phlegraei (West of Vesuvius), Ponza Islands, Ischia Island (Italy), Siebeugeberge (Hungary), Teneriffe, Guahilagua and Xalaput (Mexico) trachyte and basalt are found together. Some geologists have contended, on the other hand, that all trachyte formations are parallel to the secondary age, but against this the fact remains that trachyte is still thrown up by volcanoes and some of these volcanoes are built on Tertiary hills. If volcanoes of the Tertiary or an earlier age continue to produce trachyte rocks it must serve to show geologists that their hard and fast classification of rocks according to certain ages requires reconsideration.

UNKNOWN FORMATIONS SOMETIMES EJECTED

38. Another feature observed in regard to volcanic eruptions is that some conglomerates expelled from the crater contain rock fragments differing

entirely from any yet discovered *in situ* on the surface of the earth, and containing many minerals never observed elsewhere. This phenomenon has been observed in places like Somma (the oldest and now decayed crater of Vesuvius), Mt. Albano, Monte Cimini, the Lake of Laach, and the present Vesuvius. It has puzzled geologists because, owing to their wholly unjustifiable belief that eruptions owe their inception solely to causes below the earth's alleged crust, unknown minerals produced by an eruption must have been either existent strata broken through by a fissure although different from any shown *in situ* on the surface of the earth, or, these strata producing this anomaly are of the recognised genus, such as primary and secondary limestones, gneiss, granite, etc., but are altered by long exposure to subterranean heats to a totally different character.

38A. These alternative theories may both be dismissed, the first in that if there were any uniform strata of unknown minerals we should expect to discover such elsewhere, and also that these unknown minerals appear only rarely not as regular conglomerates in the various eruptions of such mountains *but only on special occasions.* Such, for example, was experienced in the eruption of Vesuvius in 1822. The crater ejected a great number of fragments of augitic basalt similar to those which compose the greater part of the mountain, and in so far Vesuvius was true to herself, but some of these rocks were fused into a basaltic obsidian ; on some points the leucites alone were fused ; in others they were rendered carious or had entirely disappeared, their cavities being occupied or coated with numerous beautiful crystals of melanite and by delicate acicular crystals of an unknown material. This product clearly enough had been subjected to a very exceptional degree of torrefaction, and it is significant to note that the electrical phenomena of this particular eruption was highly charged. From every part of the immense cloud of ashes hanging suspended over the mountain alarming flashes of forked lightning darted continually from the edges of the cloud. They did not consist of a single zig-zag streak of light, but coruscations appeared to dart suddenly in every direction from a central point forming a group of brilliant rays resembling the thunderbolts conceived by the ancients as reposing in the ægis of cloud-compelling Jove.

38B. The second hypothesis is also unsatisfactory, for there is no reason to accept the assertion that a volcanic eruption is an exception to the laws of nature whereby like can only produce like. The fusing of certain augitic rocks could not therefore create an entirely new material otherwise quite unaccounted for. An analogy has been sought in the change of secondary limestone into crystalline dolomite such as observed in Scotland and Ireland, the Tyrol and other places, but the ingredients in such a composition are known. It is a truism to state that the liquefaction of certain rocks may produce such and such a composite, but the liquefaction of known rocks cannot introduce some entirely new substance hitherto unknown which cannot be accounted for by any chemical analysis. *The inference is, therefore, that the presence of foreign minerals in the ejections of a volcano which do not either appear in other previous or subsequent eruptions are due to their having been introduced by some other agency.*

FLOW OF LAVAS

39. The lava flow has a further bearing on the problem of the causation of an eruption. It was mentioned previously that lavas radiate comparatively little heat in proportion to their highly incandescent state and that they quickly solidify (34). This is particularly characteristic of the felspathose lavas and these, owing to imperfect fluidity are commonly disposed in massive beds, hummocks or dunes, closely grouped about volcanic centres. It may be said of this class of lava that it is associated invariably with an eruption of low specific gravity. The less severe the particular eruption the less likelihood is there of complete fusion of the material within the crater, and also the less specific force in the manner whereby the lava is ejected from the orifice. This statement requires the qualification that the size and depth of the orifice bear a certain relationship to the ejection of materia. As in the principle of a gun-barrel the longer and the narrower the orifice of

ejection the further will the materia be hurled, granted an equal explosive charge at its inception.

40. Basaltic lavas, in spite of their heavier composition, spread greater distances, usually in long or narrow currents or streams, sometimes to considerable distances as in the great eruption of Etna of 1669, when one such stream is alleged to have flowed fourteen miles and to have been six miles wide in parts. This mobility is generally ascribed to the greater fusion of basalt due to the bigger quantities of ferruginous minerals such as augite, hornblende and iron, which retain their liquid properties longer than the felspathose rocks. So highly liquefied are some basaltic lavas that a stream from Vesuvius was observed to flow a mile and a half in fourteen minutes. Basalt is also found in broad sheets in the neighbourhood of volcanoes, and is supposed to have been the lava ejected from the crater, but this is a question to be discussed later. Why basalt should flow *either* in narrow streams *or* in broad sheets many miles in width very often is not apparent, as the two methods are in direct contrast.

41. Although the felspathose or trachytic lavas usually solidify in massive beds, hummocks or dunes (39), this is not invariable. When reduced to a great degree of liquefaction they also flow in streams of obsidian or glassy trachyte as in the Lipari Island, Teneriffe, Reunion Island (near Mauritius), Iceland, etc. The greatest distance claimed for a lava flow from a crater is said to be

forty miles, although Pennant declared that the major eruption of Skapta Jokul in Iceland in 1783 covered an area of ninety-four miles by fifty (57). In view of the rapid congealment of the lava, whether basaltic or felspathic, such claims require very close examination, not so much as to the physical existence of the lava flow, but as to the relationship between it and the crater in eruption.

Volcanic Ejections cannot Create Mountain Ranges

42. The vast Cordilleras are said to be almost entirely of trachytic construction, a range 3,000 miles in length, in places over 18,000 feet in height, and estimated by Von Humboldt to attain an average vertical thickness of 18,000 metres. In spite of the frequent volcanic activity of this tremendous chain or chains, it would be the height of imprudence to maintain that these volcanoes built themselves up from the sea level by a series of eruptions. We have no evidence that a volcano grows at all, but rather the reverse, except in circumstances to be examined in connection with superimposed craters (47). If it were so it would prove a colossal instance of a dog living on his own tail! The same objection applies to other such ranges as, for example, the Auvergne, for although we observe many extinct cones along that range there is nothing to support the theory that the great thicknesses of clinkstone were the excreta of those cones, from 500 to 600 feet thick over an area of

156 square miles. What we may discover in the French ranges are felspathic eminences, such as the Puys de Dome, de Sarçony and de Cliersen formed on other volcanic strata, and the lava flow from these cones may be contra-distinguished from previous beds of granite, basalt, clinkstone, freshwater marls and clays.

43. Much objection may also be raised to the contention that the vast beds or plateaux of basalt are necessarily ejections from a volcano or volcanoes in the vicinity. Basaltic beds, though usually proximate to cones, are not necessarily in their vicinity, and sometimes cover an area which even a system of volcanoes could not account for. Sir Archibald Geikie has outlined such a basaltic sheet in the British Isles during the Tertiary Age* and a brief account of this sheet is instructive :—

(*a*) The Antrim plateau, the largest, most continuous and regular in the British Isles, " may be regarded as one unbroken sheet of volcanic material," but nowhere exists a trace of any central vent or cone.

(*b*) Antrim, Mull, the Inner and Outer Hebrides, including Skye, are mainly of old red sandstone and red clay over which the basalt rolled.

(*c*) Mull formerly extended far beyond its present limits, at least as far as the Treshnish Islands, which are composed entirely of basalt. The vegetation in these parts prior to this basaltic flow was sub-tropical, for below the lava have been found a specimen of a large purple ginkgo and a fine *plantanites*, one half measuring 15½ inches long by 10½ broad. A vertical tree trunk was found by MacCulloch imbedded in prismatic basalt, " a large trunk of a coniferous tree, 5 feet in diameter, perhaps *podocarpus*, enveloped to the height of 40 feet." Its solidity and girth enabled it to resist the fire, but its trunk is a hollow cylinder filled with *débris* and lined with the charred wood. There is no evidence to show from whence proceeded this basaltic flow.

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* Sir A. Geikie on " The History of Volcanic Action during the Tertiary Period in the British Isles," *Royal Society of Edinburgh Trans.*, vol. 35, pp. 87–182.

(*d*) " In no one instance," says Geikie, " have I been able to discover a trace of any central volcano whence the sheets of basalt in the British plateaux could have proceeded." The indications point in his opinion " not to a few great volcanoes, but to many minor vents breaking out one after another and shifting from district to district. Only by such distribution of the foci of discharge can we account for the continuity and horizontality of the basalts that have gradually built up the plateaux."

(*e*) This volcanic phenomena extended over a region of more than 40,000 square miles.

(*f*) The volcanic region underwent elevation while simultaneously a vast subterranean lake or sea of molten rock appeared beneath it, whence enormous tension and ultimate collapse.

(*g*) A series of parallel fissures opened whose simultaneous production of a gigantic series of rents " must have given rise to earthquakes of enormous magnitude and destructive force."

43A. I cannot accept all Geikie's conclusions as inferred from the existing evidence, because there are a number of other factors which, when considered in conjunction with this basaltic flow, point to a totally different origin than some imaginary vast subterranean lake of molten rock, although that may have been one of the effects. Nor can we justly accept his theory of a series of small volcanoes succeeding one another without a trace. What we do perceive is that this basalt fell over an area of 40,000 square miles, and in spite of the devastating effects of this enormous operation no sign of a single volcano was discovered by the great geologist.

44. We may summarise, therefore, volcanic ejections by saying that their effects are in proportion to their severity. The production of their lava follows usually the character of their strata, but not invariably, for on occasions unknown minerals are introduced (38) and, while the lava flow of volcanoes is known to extend to some distance, there is nothing to support the contention of certain vulcanists that our vast mountain ranges were built up by volcanoes.

MATERIA AND FUSING

44A. The difference between the felspathic or trachytic lava and the basaltic resolves itself into the problem of the complete fusing of the various materia within the crater. It is not difficult to conceive the transformation of a granite original to ordinary trachyte ; for the process of intumescence may be presumed to transfer the felspar crystals from compact to vitreous, to dissolve the whole or the greater part of the quartz, and so forcing it to assume the crystalline form of felspar on consolidation ; finally to volatilise the mica, part of which recrystallises in more perfect crystals, either of mica or augite on cooling, and a part gives rise to specular or magnetic iron disseminated through the rock or lining its pores or fissures.

44B. The production of basalt may be likewise due to the exposure within the crater of an intumescent mass of granite subjected to extreme heat which would volatilise the mica and other ferruginous minerals while the intense pressure separates them in a gaseous state from the felspar, thus leaving a felspathose lava with very little iron in one part, and occasioning the crystallisation of a highly ferruginous basalt in another. What determines the different temperature is an unknown quantity, but electrical energy and the introduction of certain gases which manifest themselves evidently play a considerable part in the complete fusion or otherwise, and determine largely, if not entirely, whether the volcano gives birth to trachyte, clinkstone, compact felspar, or basalt and greystone or some of the rarer rocks produced by volcanic means.

THE VOLCANO A RECEPTIVE AGENT

45. That the determination of a basalt or trachyte is due to some ulterior force, of which the volcano is merely a receptive agent, is demonstrated by the fact that many, if not all, volcanoes can produce either the one or the other. Thus, in the Auvergne, Mt. Dore, Mt. Mezen and Mt. Cantal at one time produced alternate currents of basalt, trachyte, and clinkstone. In the neighbourhood of Monti Cimini and the Campi Phlegræi, among other parts of Italy, trachyte and basalt occur together. At Mt. Guahilagua and Xalapa, in Mexico, the two classes appear to have been successively erupted from the same or neighbouring vents. Most of the active volcanoes of the present day, in Italy, Iceland, South America and Java, appear to eject trachytic formations. Stromboli, perhaps the most interesting volcano in the world, as it is certainly the most consistent, produces lava of augitic character, and has a high specific gravity. Although its lavas are chiefly a black, dense and heavy augitic, basalt rocks of felspathic character are found on the island. Ischia Island, south-west of Naples, fortunately for that city, has remained quiescent since the fourteenth century, but in early historical times was celebrated for its frequent and extremely violent activity. Its lavas are felspathic, very beautiful and varied, some highly porphyritic, others marbled, with tufas remarkable for their greenish tints, due probably

to the abundance of augite in the lavas. The eruption of Vesuvius in 1822 already noted (38A), when a basaltic obsidian was ejected not only testifies to the extreme violence of that eruption, but also points to the fact that in spite of an apparent tendency on the part of volcanoes to produce trachyte the more solid basalts can still be created in given circumstances.

46. The consideration of lavas leads to the conclusion that whilst it is the function of volcanoes to give birth to composite rocks, and whilst they repose on strata which may be of the Primary, Secondary, or Tertiary Ages, they cannot account for the vast mountainous chains of volcanic materia. In the laws of creation the volcano appears to stand for the feminine principle as being a receptive agency, subject to violent ebullitions of activity due to originating causes not from within the womb of the volcano but to ulterior action, whence only can be explained, the presence of unknown conglomerate rocks sometimes ejected (38 to 38B). The volcano acts the part of Hera, the earth, as the recognised but inferior consort of the divine Zeus, to give birth to his various offspring.

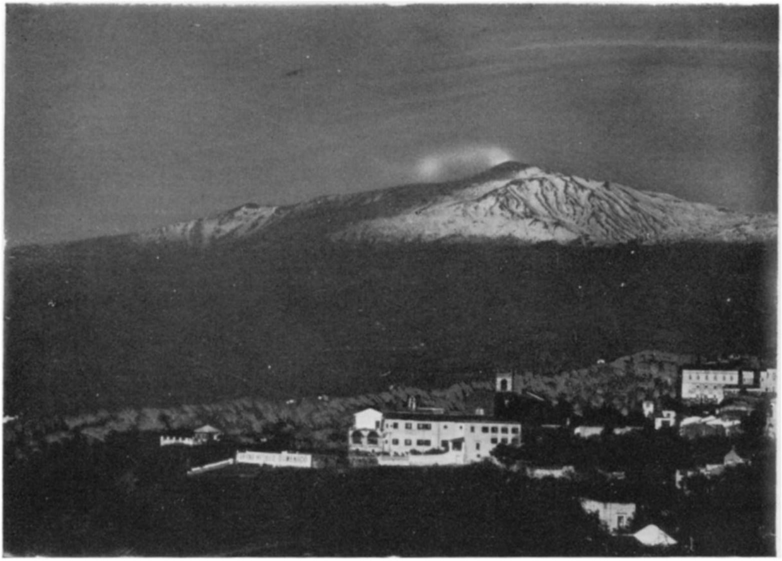
CHAPTER V

THE CREATION OF VOLCANIC CRATERS

CRATERS AND PARASITIC CONES

A VERY instructive insight into the entire incidence of volcanic eruptions may be gathered from the examination of craters. It very rarely happens that once a volcano is established it retains the same crater. We continually find new craters thrown upon the old and also with those mountains in frequent activity, like Etna and Vesuvius, a number of parasitic cones or smaller volcanoes are sprinkled in the vicinity. The present crater of Vesuvius is superimposed upon a pre-existent volcano called Monte Somma, which originally formed a single conical mountain with an enormous crater. Between the years of 1139 and 1306, as mentioned (29), Vesuvius, or more probably Somma, remained in a state of *solfatara*, as it is called. The energies of the volcano were exhausted, all appearances of igneous action effaced, except certain *fumarole*. These fumarole are gases or vapours which escape in considerable quantity from numerous crevices in the sides of a volcanic mountain immediately after the termination of an eruption and when the crater

MT. SOMMA, A VIEW OF THE ANCIENT CRATER.



MT. ETNA, A VIEW FROM TAORMINA DURING ERUPTION IN APRIL, 1908.

[*To face p.* 56.

has been sealed with lava. The fumarole form thermal springs and generally contain various mineral acids and saline properties. When the acidity of these vapours is in excess and their production continues for a long period they decompose the rocks against which they act, and the crater of a volcano in this condition is said to pass into a state of *solfatara*, or, as the French term it, *soufrière*.

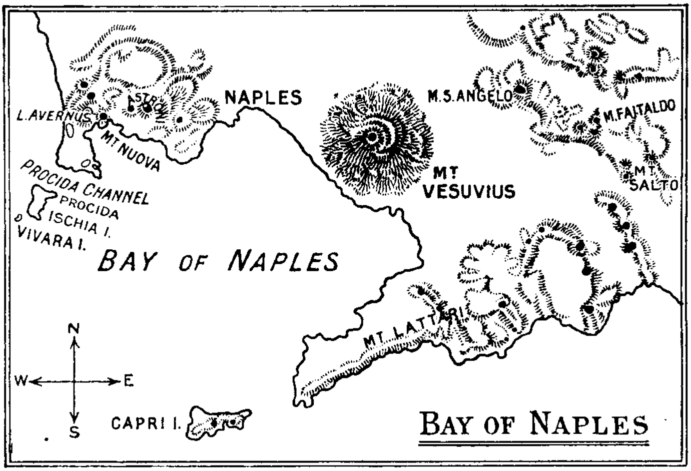
48. Somma, therefore, between the years of 1139 and 1306, lay in this state, and its cavity or crater so far decomposed that it was cultivated. It seems to have been again in a state of *solfatara* until 1538, when a portion of the old crater appears to have erupted, but the real centre of the eruption of that year occurred by the sudden phenomenon of a new volcano called Monte Nuovo, seventeen miles to the west, on the borders of the Bay of Baja. This volcano was deposited in the southern part of the Phlegrean Fields (Campi Phlegræi), the centre of a very ancient collection of denuded volcanic cones. This new mountain appeared indeed upon the site of Lake Avernus, formerly a volcanic crater whence carbonic acid and azotic gases were exhaled. It is said that warmth is still felt at the bottom of the crater of Mt. Nuovo, and very thin vapours escape from some of its crevices. If these still persist Mt. Nuovo is in a state of *solfatara*, and is, I shall prove in due course, liable at any time to become the centre of a catastrophe.

VESUVIUS, ETNA, AND THEIR AREAS

49. From the year 1538 Somma slumbered in repose until 1631, when a very violent paroxysmal eruption took place, and it appears to have then formed its new crater upon the old, rising from the centre of a semi-circular enclosure of precipitous cliffs of basalt and scoriæ. In 1670 eruptions burst out simultaneously from fifteen different points of a fissure broken from the summit to the base of the mountain, and since then few years have passed by without signs of activity in this highly charged volcanic mountain. Its lavas have consisted for long of leucitic basalt, but the conglomerate strata of Somma indicates formerly a felspathose or trachytic composition, so a change has occurred and the question may be asked, Whence came these subsequent basaltic lavas? Whence this leucitic basalt? The extinct volcanoes of the Campi Phlegræi have almost uniformly produced trachytic lavas. We have therefore to postulate in the case of Vesuvius a new volcano superimposed on the crater of an older mass which ejects lava in a higher state of incandescence than formerly, and as it grows older shows greater strength than before.

50. Before leaving the neighbourhood of Vesuvius it should be pointed out that we find here a system of extraordinary volcanic complication. It is possible that Vesuvius owes its existence to the earlier meteoric attraction of Campi Phlegræi

in its vicinity, or it may be the other way about. Certainly it is ringed with volcanic vents. From ten to fifteen miles away in the east and south-east we appear to find two parallel lines of volcanic vents in many cases superimposed on older craters. The more easterly line terminating at Salerno includes at least nine such mountains, and the more westerly four or five, including Monte St. Angelo, a spur which terminates at Cape Orso. The Lattari Mountains to the south of Vesuvius contain several extinct cones which terminate in Capri, a volcanic island. In the west lie the Campi Phlegræi with some half a dozen pronounced volcanic craters, as well as others decomposed, the most notable being Mt. Astroni to the right of



Mt. Vesuvius, showing the various cones (in black circles) scattered in its vicinity, most of them revealing systematic linear directions. Astroni, Mt. Nuova and Lake Avernus are on the left of the map.

Monte Nuovo, a considerable burnt-out volcano superimposed on a recumbent former crater whose walls yet survive on the south side. From this considerable collection of outlying small volcanic masses, mainly long since extinct, we may imagine Vesuvius as the target and they as the missiles. The appearance in fact of this great volcanic field is of a very ancient linear arrangement first laid down in one of the earlier ages which continued in active existence and became the attractive force to later volcanic deposits of the Tertiary Age.

51. Etna presents many similarities to Vesuvius. This great mountain, the loftiest volcano in Europe, with a height of 10,874 feet, and a diameter of ninety miles at the base, has experienced more vicissitudes even than Vesuvius. Its slopes are sprinkled with over seventy parasitical cones, the largest of which is about 700 feet. The east side contains a remarkable depression called the Val del Bove, the original ancient crater which forms walls or an amphitheatre five miles in diameter, surrounded on three sides by precipices from 1,000 to nearly 4,000 feet in almost perpendicular height. The terminal cone, 1,100 feet high, emits from its sides sulphureous vapours and expels generally a felspathose basalt sometimes passing into greystone.

MONTE ROSSO A METEOR DEPOSIT

51A. The interesting feature of Etna is its parasitic cones, so-called, each of which has its crater and each marks the source of a stream of lava. Scrope mentions one such cone which he visited in 1819, the residue of the great eruption of 1794, and it was then actively in existence at its base, although now dead. But its most remarkable eruption perhaps was that of 1669, when the south-east flank of Etna was split open by an enormous fissure, reaching from the summit two-thirds of the distance down the mountain. At the same time the large cone, called Monte Rosso, was created and covered a circuit of about two miles with a deep deposit of black sand containing innumerable crystals of augite. It was the lava stream from this mountain which destroyed Catania at that time, and the eruption was marked by an earthquake of unprecedented severity. The orthodox view is that the internal heats of the earth caused the eruption of Etna, and the eruption was of sufficient violence to eject this mass of Monte Rosso after causing a fissure owing to the pressure of the lava within. Against this we must set the established fact that ejections of basaltic character flow in sheets or streams, and that as ejected they do not form solid masses with a separate and independent crater. In this case we are asked to believe not only that the natural laws governing the ejection of lava were defied, but that this volcano produced a separate lava from the main crater, and sufficient of it (as was the case) to destroy Catania some miles to the south.

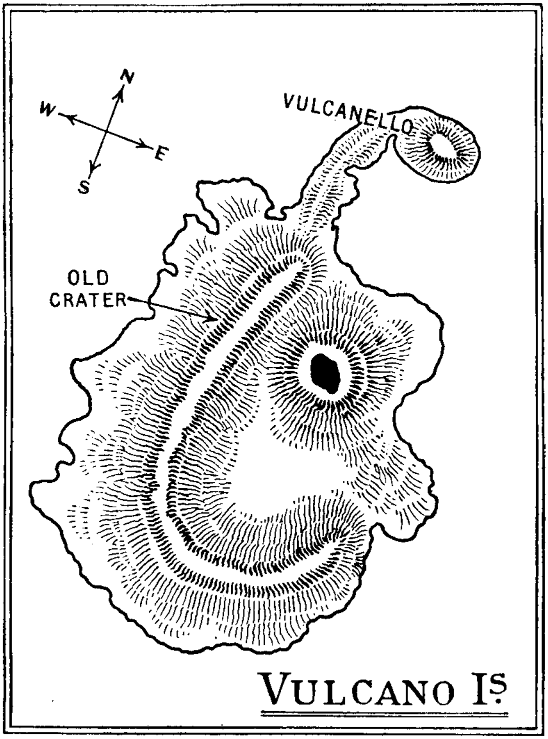
52. The explanation of this event, as in all other

sudden major eruptions, is that a considerable meteoric body was attracted to Etna, but that it, as so frequently experienced, only partially struck the mountain along its south-east flank as it fell tangentially. Part of the meteor caused the enormous fissure and the great eruption, while the residue or bulk formed this new cone Monte Rosso, thus accounting for the black sand with augite crystals. This same cause—meteor impact with a volcano or close contact with the same—is the only scientific explanation of an otherwise inexplicable mystery. It explains the number of minor cones, supposed to be ejected in one heap, which burn furiously at birth and usually die down for good and all. It explains the superimposed volcanic cones, like Etna's herself, thrust upon the old crater in a state of *solfatara*, for otherwise if the internal pressure and heat were to demand an outlet it would seek it along the line of least resistance—the crater's mouth—and not either deposit itself in a part of the pre-existing crater or drive an enormous rent through the envelope of the mountain. The very shape of such cones, wide at the base and tapering to the crater, proves this.

METEORS FORMING SUPERIMPOSED CRATERS

53. Wherever we turn the appearance of a foreign body thrown higgledy-piggledy upon a pre-existing crater confronts us. Another example is the mountain called Vulcano in the Lipari Isles.

This small island contains an ancient crater enclosed by a semi-circular range of cliffs, and upon it is superimposed another crater either in a state of *solfatara* or extinct. The later crater lies in the northern centre of the older and greater orifice. Another feature of this island is that almost due north of it are the remains of a parasitic cone called Vulcanello, joined to the island by lava rocks. The old crater of Vulcano is choked up

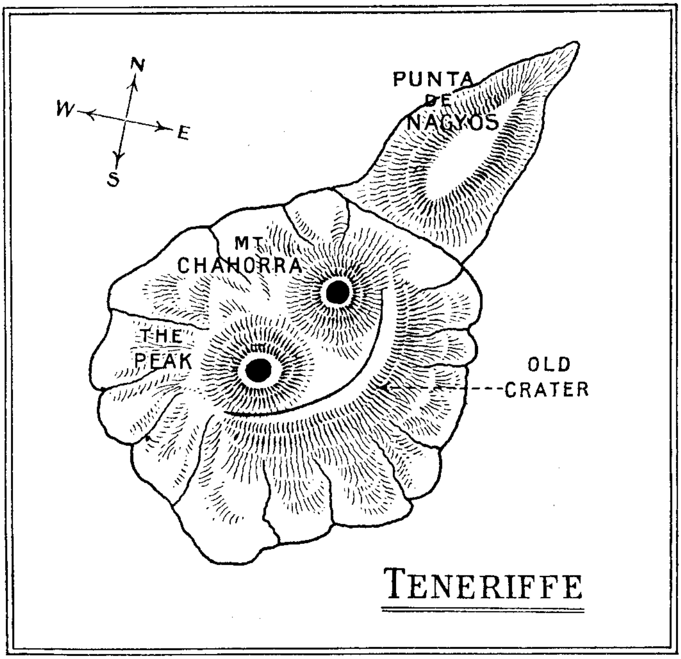


Vulcano, with Vulcanello, N.E. by N. with part of the original crater of Vulcano and the later superimposed crater within.

with the *débris* of the later injection. A similar position is discoverable at Réunion Island, near Mauritius, formerly constantly active. Again we find the semi-circular enclosure of precipitous cliffs of basalt and scoriæ, the relics of a former vast orifice upon which has impacted a new cone. On this island stands also a primitive volcano occupying most of the island, but it is long since extinct and probably while yet in a state of *solfatara* it attracted a meteor which missed the mark, formed a new crater beyond, and upon this there duly appeared another meteor, thus forming an active volcano. Meteors or meteorites attracted magnetically to an existing volcano very often miss the mark and fall in the vicinity. When this occurs they form new and minor cones, according to size, or if they strike the orifice, they raise new cones on the old or, it appears, when they strike the mountain on its sides instead of coming into contact with the crater, cause a fissure.

54. The Canary Islands offer some evidence of the contributory factors to volcanic eruptions. The Peak of Teneriffe stands 12,140 feet above the sea and is in the shape of an oblong cone, although its regularity has been disturbed by the products of numerous " lateral " eruptions. The principal crater evidently once occupied the centre of the ellipsoidal base and corresponded with it in shape and dimensions. Half of its enclosing walls remain to the south and south-east, within whose great area rise the more recent cones of the Peak

and Chahorra, the latter to the north-west of the former and apparently later. When Teneriffe bursts into eruption the active factor is Chahorra, so we apparently find here two volcanoes sharing a huge former crater, and Chahorra has succeeded the Peak. A curious feature of this island, like that of Vulcano (53) is that the north-east side contains a headland with the remains of a cone of a long oblong form, composed of vast horizontal beds of basalt and basaltic conglomerate, whereas



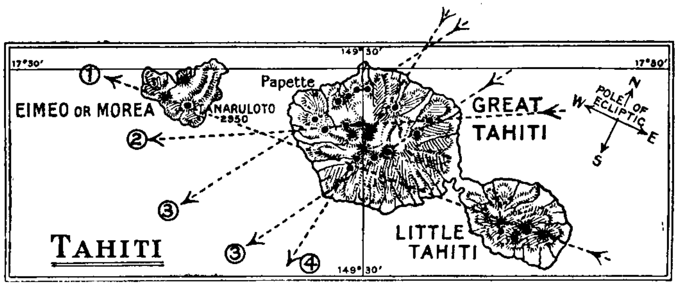
Teneriffe, with the meteoric deposit, Punta de Nagyos, to N.N.E. and with Chahorra and the Peak all in alignment. The two cones lie within the mother crater.

the rocks of Vulcano and the Peak and Chahorra are wholly trachytic. The inference from the foregoing is that this headland or adjunct of the island, of totally different construction, is the decayed remains of a meteor which fell just short of the volcano.

54A. A little further consideration may be given to these two island volcanoes just mentioned, viz., Vulcano and Teneriffe, in connection with Tahiti in the Pacific Ocean. Vulcano lies in the meridian between Stromboli and Etna, and appears to have been one of those meteor falls drawn to the vicinity of the greater and older volcano. Its history shows a little more than that, for the existing crater set within the greater crater of the original indicates that we have here a meteor residue (denoted by the size of the original crater), with another impact in the form of the latter crater, and beyond this, to the north (slightly north-north-east) is this Vulcanello, or Little Volcano, another meteor body which fell short, coming from the direction of the Ecliptic Pole. At one time, therefore, Vulcano was a centre of considerable activity. Again, we discover in Teneriffe the Punta di Nagyos, whose vast horizontal beds of basalt and the long elliptic crater show that here we have another meteoric body which also missed the actual mountain, and this interesting formation lies definitely north-east, thus pointing out that the meteor now forming a part of Teneriffe came from the north-east, or the direction of the Ecliptic

Pole. The meteoric dumps of Stromboli to Etna, Punta di Nagyos to Teneriffe, and Vulcanello to Vulcano, all emphasise the principle of direction from the North Pole of the Ecliptic or, it might be said, from the regions of the sun.

54B. Curiously enough exactly the same principle, of the meteor falling short at the foot of the big volcanic mountain, is found in Little Tahiti, with this difference that the bulk lies to the north-west (Great Tahiti) and the smaller island is connected by volcanic materia to the south-east, a reversal in direction of the system in fact which we have been studying, of meteoric bodies from the north or north-east. Great Tahiti was originally one vast meteoric dump, an island of 400 square miles, with the walls of its old crater about twenty-five miles in circuit. The place is studded with volcanic cones, eighteen on Great Tahiti, four in Little Tahiti, and three, with the remains of a huge



Map of Great Tahiti, Little Tahiti and Eimeo, showing the volcanic strata built up on four separate occasions. No. 1 shows the apparent first linear direction resulting in the formation of the volcanic islands. The attractive and active centre in Great Tahiti led subsequently to three other directional lines over great ages.

cavity on Eimeo (or Morea), fifteen miles beyond Tahiti, *along the same line of direction, viz., south-east to north-west.* I do not think there can be any doubt that such was the line of construction of those islands, and an instructive point is to note the lines of volcanic cones on Tahiti ; one system, the most important in numbers and size, follows the line of demarcation Little Tahiti—Tahiti—Eimeo ; another, on the north side of the island is from north-east by east to south-west by west, and there are four or five in a line ; the third seems to be north-north-east to south-south-west, but perhaps one or two in this line belong properly to the main line. I assume that these lines of direction correspond to the changes in the North Pole, and indicate the island's position in various stages of the Primary and Secondary Ages. As none of these volcanic systems was laid down from the west, but always from the east, or, rather the Ecliptic Pole, we have a further support of the theory already outlined of geological ages and earth construction (24). Tahiti belongs to the earliest geological ages ; Teneriffe, long after, is nevertheless very ancient, and Vulcano is apparently younger still, belonging to the Tertiary Period, judged by the linear direction of their volcanoes—assuming always that such lines were laid down from the direction of the Pole of the Ecliptic.

55. Palma, another of the Canaries, offers the example of a perfectly regular and complete insular volcanic mountain. It rises from its circular coast

at first by gently inclined slopes which become more rapid until they terminate in the ridge which forms the summit of a steep range of cliffs encircling its central crater. A few parasitical cones are sprinkled on the surface of its slopes. It is over 200 years since Palma burst into eruption, but in 1677 both this volcano and that on Ferro were greatly disturbed, and new parasitical cones were created.

56. Lancerote, another of the Canary group, in 1730 produced various phenomena. Numerous vents opened upon a direct line from north to south, continuing with a new pyramidal rock which rose above the water level. These miniature volcanoes continued in active eruption for the space of three years on the authority of Von Buch, a great part of the island's surface was deluged by lava currents of a basaltic character, and the remainder was buried under showers of scoriæ and ashes.

57. The Icelandic mountains yield evidence of having been in the past the focus of vast volcanic forces unsurpassed in any corresponding region of the world, and they still retain their awful potentialities. The most interesting record of modern eruptions there was that of Skapta Jokul in 1783. At a distance of thirty miles from the land simultaneously with a prodigious earthquake a new island appeared consisting of high cliffs, but within a year it sank leaving behind a reef of rocks five fathoms under water. At the same time three volcanic cones appeared about eight miles distant

from one another, forming a straight line with the new island at one extremity and the volcano at the other, from whence lava issued in prodigious quantities covering a superficial area of more than forty miles by thirty. These new volcanic cones were dumped on the plain, and altogether from extreme to extreme this disturbance spread for over fifty lineal miles. Before the actual event Skapta Jokul emitted gaseous explosions, and for some time after continued so to do. The explanation of this phenomena was said to have been that a fissure was caused in the strata of the plain by the upward pressure of the lava to which the framework of the volcano offered a greater resistance than the superincumbent beds at its foot. It fails, however, to explain why, in such a major fracture, the volcano itself only developed a comparatively mild interest, or, why, with the volcanic vent in action the lava did not pursue the natural method of seeking an outlet *viâ* the crater. These unsatisfactory theories to account for volcanic action are solely due to the preconceived bias that the lava exists from all time in a liquid state in the bowels of the earth, and merely seeks an outlet. If the above theory had the slightest justification we should expect that the expulsion of subterranean lavas was of frequent occurrence. The only complete explanation is that a meteor of large size was attracted to Skapta Jokul, then emitting vapours, but fell tangentially before it reached the volcano. Such a meteor would account for the earthquake, the dumps of material each with a cone, and the comparatively mild eruption of Skapta Jokul itself, as the meteoric gases would have been consumed by the various small volcanoes deposited.

58. Perhaps the most instructive example of the real origin of volcanoes and the part they play was the creation of a big volcano in Southern Mexico in 1759. The details of this extremely important scientific event have fortunately been preserved by William von Humboldt, the great traveller and physicist, who visited the spot a few years later and gathered the fullest particulars. Until September, 1759, the plain in which the volcano Jorullo stands to-day was flat, but of prior volcanic origin, as the soil of tufa and the volcanoes in the vicinity of basalt and trachyte denoted. In that month I possess no record of preliminary disturbances such as the earthquake which must have occurred, but Von Humboldt reports a violent " eruption." There appeared suddenly on the plain occupying an area of about four miles, no less than six volcanic cones and thousands of little " hillocks " all burning furiously, while the plain itself became elevated by some hundreds of feet. The greatest of these volcanoes was Jorullo, in Von Humboldt's time, said to be 1,700 feet high, but to-day 4,331 feet in height.* The details of this significant event are as follows :—

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* Von Humboldt's estimate is taken from Scrope. Perhaps " feet " is an error for metres.

THE CREATION OF MT. JORULLO IN 1759

58A.—(*a*) Six volcanic cones appeared composed of scoriæ and fragmentary lava. From the greatest of them all the cone, subsequently named Mt. Jorullo, alone ejected a basaltic lava. The others expelled ashes and vapours.

(*b*) Simultaneously with the above the plain was elevated in a convex form over an area of four miles (superficial), the centre occupied by Jorullo, whose base is 550 feet above the previous level.

(*c*) The new plateau consisted of horizontal layers of black clay in which augite crystals were thickly interspersed, as also concentric balls of basalt.

(*d*) Great fissures opened up in the plain.

(*e*) The surface of the plain was sprinkled with thousands of flattish conical hills or hillocks from 6 to 9 feet in height, of basaltic balls imbedded in the black clay. These hillocks emitted thick clouds of vapour combined with sulphuric acid at a very high temperature.

(*f*) The six volcanoes were arranged along a single line.

(*g*) Enormous rain succeeded this episode.

(*h*) Two rivers which drained the plain afterwards filtered through the crevices and reappeared as hot springs, but twenty years later the heat had decreased noticeably.

59. The phenomena of the above is remarkable because no volcano existed in the area prior to the

date of this event, and the theories of geologists that these volcanoes and the thousands of burning hillocks were thrown up at the same time as the plateau of black clay and augite crystals by some subterranean agency fail to carry conviction. If subterranean agencies were to expel vast quantities of rocks, lava, black clay, acids and gases, expelling them *en masse* from the bowels of the earth we might premise a liquid lake of molten materia, but not six solid volcanoes and thousands of little hillocks. Indeed, the very form of a volcanic mountain is in itself sufficient evidence that it was dumped on the earth from the skies and not projected through the earth. One can take the common example of a waggon unloading sand or other material, which, as it is tipped out, forms a mound or pyramid, and apply the same principle to a mountain ; whereas if a subterranean explosion ejects any materia it is thrown without system or order. The case of Jorullo affords an absolute contradiction of the theories so laboriously built up by geologists that volcanoes build themselves up gradually from the plain by emissions of lava, *for here six volcanoes and innumerable burning units appeared all at once.*

I do not possess the data to say what particularly attracted the meteor to the spot where it fell, but it will be seen presently that meteors or comets contain all the ingredients of the earth, fly through the heavens at a furious pace, and in a highly incandescent state. The only possible explanation of Jorullo's birth is that a meteor fell on the spot.

CHARACTERISTICS OF STROMBOLI

60. Examination of individual volcanoes demands some mention of Stromboli. This is peculiar because it is almost the only volcano existent, if not the only one, which is never wholly quiescent. It is in extent and height not a big volcano, but it rises abruptly out of the sea on an island which is nothing but a continuation of the volcano, and yet as far back as records carry us it has emitted fire and smoke. In the past it must have ejected very considerable streams of lava, chiefly of a black, dense and heavy augitic basalt, but there are rocks of felspathose character on the island (45), although their presence does not necessarily denote that they were expelled from the orifice. To-day, in its eruptions, gases escape by successive explosions from the same vent as fast as generated within the subjacent mass of ebullient lava, but this never appears to overflow the lip of the orifice and rarely is expelled except as ejected scoriæ.

61. The explanation of the above is probably due to the peculiar circumstances of the conformation characterising the cone of Stromboli. This cone, unlike so many others, is as it was originally formed, on the south side bounded by a high semicircular ridge, while immediately from its lip on the north side, a steep slope commences, reaching to the sea, and inclined to an angle of 45 degrees. This considerable crater, with its northern slope

descending to the sea, has consequently been drained of its superfluous lavas. The natives declare that it is sometimes split open in the storms of the winter months and discharges lava into the sea, thereby destroying fish, which rise to the surface in a boiled condition. It is perfectly evident that the formation of Stromboli's crater is such that the retention of any considerable quantity of lava is impossible, because as it rises and falls within the orifice any surfeit dribbles over or is expelled. At the same time the lightness of its lava reserve is such that comparatively very little is needed to send it into action, so that the volcano is extraordinarily sensitive to gaseous vapours. But without the activity of two such volcanoes as Vesuvius and Etna to act as decoys it seems likely that the active sphere of Stromboli would have ceased long ago.

62. The points to be noted in connection with Stromboli are that its crater has been widened by a great fissure which at some past date split the mountain almost in two, and has remained open instead of becoming sealed with lava as in most fissures ; that its cone definitely points to the north ; that it is situated almost directly due north from Etna about seventy-five miles distant ; that the Lipari Islands, of which it forms one, including also Lipari, Vulcano, Panaria, Salina and one or two others, lie in an almost direct line from the north to Etna ; that all these islands are volcanic and possess cones or the remains of cones ; and,

after considering these facts in connection with that great volcano, it is permissible to presume, after the examples of Skapta Jokul and Jorullo, that these islands are merely the depositories of past meteoric falls which have fallen into the sea without quite reaching Mount Etna herself (53). I might go further and allege that even Vesuvius and many of the volcanoes which have clustered around her nucleus are actually satellites of Etna, the parent cone. More probably, however, Mt. Somma was the parent of the Italian crop of volcanoes because there are linear indications of an east to west direction in which Somma or one of the extinct volcanoes in the Campi Phlegræi was the attracting centre, and we do not find this in the case of Etna, which appears to be rather an outcrop of the Calabrian Mountains to the north-east. The principle remains in any case that at some early date, either of the Secondary or early Tertiary Periods, the deposit of a large meteoric body set up an acute volcanic area and subsequently attracted other falls to the vicinity. In this area Stromboli has survived in active form in spite of her comparative insignificance because a vast fissure torn in her northern flank did not close up as is usual, and because of the presence of Vesuvius and Etna, between which foci of attraction the mountain lies.

FISSURES

63. Fissures are explained by vulcanists as lateral eruptions caused by the expansion of lava

exerting a strain upon the internal walls thus bringing about an explosion resulting in a long rent or fissure out of which the lava pours. Nearly every volcano of importance bears the scars of such fissures including Etna and Vesuvius and within the last century on more than one occasion. It is frequently the feature of a major eruption that at the crisis, coincident with a tremendous explosion and earthquake, a vast vertical fissure or split is observed in one of its flanks, and almost invariably on the north or north-east side. It occurred in the Mt. Pelée eruption of 1902, when the inhabitants of St. Pierre were killed outright. It would be difficult to discover any volcano that does not bear the marks of fissures closed up by lateral eruptions of this nature.

63A. There are, however, other considerations to be taken into account. Sometimes the intumescent lava blocks up the fissure giving rise to injected veins or dykes which are usually of compact basalt or of rocks subjected to intense fusion, and these veins are found of a wholly different mineral composition, from the volcanic rocks they have displaced.* Also where the crust has been thus broken they open inwards and diminish in width towards their lower extremity, as though an enormous wedge had been driven into the mountain's flanks. Serious doubts must, therefore, arise as to whether these fissures originate internally or externally. These are increased by the fact that commonly such fissures only arise in the northern or north-eastern flanks of a mountain (except as in the case of Etna in 1669, when the south-eastern flank was torn though from the direction of the north) for there can be no explanation on the theory of an internal strain why the point of fracture should be almost invariably on the north side. The resistance cannot always be the weakest on the north flanks ! Moreover, why should fissures, if internal, always take the form of a long, comparatively narrow *vertical* split, either from the crater to the base or at any part of it ? For if there be any weakness in the walls of a volcano if subjected to internal strain, it might be expected to take a horizontal direction across or towards the base, for the reason that the seat of the greatest caloric or heat, whence any resultant strain upon the envelope, lies in the womb of the volcano and not towards its orifice. Indeed, if the theory of internal causes account for a fissure, a horizontal break crosswise or horizontally would be the natural outcome, and this omission is a very strong factor against such a theory. Correspondingly the vertical split where the internal strain must be least, suggests that it is due to some cause other than internal.

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* Scrope on "Volcanoes," p. 34.

63B. When, accordingly, we examine the phenomena of a so-called " lateral " eruption, and find that (*a*) it occurs on the northern flanks ; (*b*) the fissure closes up of rocks very highly fused, frequently of different mineral construction to the fabric of the mountain ; (*c*) the fissure opens inwards instead of outwards, as it should do if the explosion and fracture were of internal origin ; (*d*) and the fissures are vertical often far removed from the base of the mountain, instead of horizontal across or near the base, it leads to a definite conclusion that the origin must be sought in some external and not internal agency. Everything points, in short, to a fissure being no other than the nucleus of a meteoric body which flings itself upon the volcano's flanks, coming from the north or north-east, and tearing a rent in the mountain sides as it plunges into the interior, thence setting up a violent eruption. We can trace in these matters the normal effect of such a meteor passage in the magnetic attraction which draws it to the volcano. Sometimes it falls short, creating volcanic cones either as islands in the sea or as mountains like Monte Rosso clustering in the neighbourhood of the volcano ; sometimes it strikes the crater and erects a new cone on a portion of the former one ; and sometimes it strikes the mountain in its flanks and causes a " lateral " eruption. It may also represent a combination of any two of these or even all three, as seems to have been the case with Skapta Jokul.

SUBMARINE VOLCANOES AND ISLANDS

64. There remains only one aspect of the structural side of volcanoes, namely, the so-called submarine or subaqueous volcanoes. From early days

islands have suddenly appeared above the surface of the oceans or seas invariably with volcanic cones burning or with evidences of having been in eruption. Their appearance is explained as occasioned either by a submarine earthquake or by volcanic action under the sea, and they are almost always discovered in close contiguity to a volcano which is in eruption or which bursts into eruption. That the theory held of an earthquake being the cause of a volcanic island should be possible displays the crude ideas yet extant on the question of seismology and is a fantastic application of the assumption that a shrinkage of the earth's crust can throw up an island or islands with burning volcanoes. It is, however, only a degree more extraordinary than that a volcano can throw up a burning island perhaps thousands of fathoms from the sea bed. In regard to such islands the two most recent examples, *e.g.*, the island off Saigon, French Cochin-China (5), and the Japanese earthquake of September 1st, 1923 (12), there are no records of volcanic activity other than the islands' cones, although both instances occurred in very active volcanic areas. It is difficult to comprehend how any person of scientific understanding could formulate such a theory to explain the phenomena, namely, that a conical mountain could be thrown up on an island from the depths of the seas, for how could a speck in the ocean, a mere islet, be projected upwards through hundreds, or even thousands, of fathoms without the waters extinguishing the subterranean fires ? And if an island could be projected upwards in spite of the forces of the watery element how is it that these islands generally, as soon as they have appeared, burn fiercely for a very short while and then both volcano and island sink under the waves ? It appears to be a false theory simply coined to account for phenomena deemed to emanate from the lower regions.

65. This hypothetical doctrine, as it has become through lack of reasoned criticism, is based on the supposition that the ocean bed is closer to the imaginary heated and incandescent inner nucleus of the earth (25), and as the ocean bed frequently yields volcanic particles these are deemed to prove the existence of submarine activity. The sea is sometimes observed to be greatly agitated, heated and discoloured, with rising columns of gaseous fluids, whirlpools and waterspouts in the vicinity, and sometimes jets of fragmentary materia are reported, but only when the result shows that the submarine volcano has at length elevated its cone above the water level is it termed sub-aerial instead of sub-aqueous. Many such occurrences are reported by masters of ships who may be within the locality of such a disturbance. For example, on March 2nd, 1895 (a very pronounced year of earthquakes, eruptions and unseasonable weather, with intermissions in June and September), an earthquake or submarine eruption was reported by vessels arriving at San Francisco. The disturb-

ance occurred in the bed of the Pacific, was accompanied by a loud roar, coming apparently from the sea, which became covered with a mass of white foam and subsequently rose in numerous geyzer-like columns. Reports of a similar nature are by no means infrequent.

66. The works of Herodotus, Thucydides and Pliny contain many records of earthquakes, eruptions and new-born islands. The island of Rhodes (originally called Æthræa and Ophiussa) was said (by Strabo) to have been raised from beneath the waves by Helios,* who had exceeding honour in consequence, four white horses being sacrificed annually to him. Poseidon, the earthquake god, was also greatly honoured in Rhodes. Its first inhabitants, the Telchines, were destroyed by a deluge. In 197 B.C. a small volcanic isle appeared near Rhodes, which State took possession of it, and there the Rhodians built a temple to Poseidon Aspheleios. Pliny tells us that Tenos, a small island in the Ægean, near Delos, about fifteen miles in circumference, was also called Ophiussa, because it "abounded in serpents." It had a celebrated temple dedicated to Poseidon, and the reference to serpents evidently means fiery "serpents," the emission from a volcano. Thucydides, in his history of the Peloponnesian War, describes

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* Helios was not the Sun, but Sirius, the Sun of Suns, greatly adored by the ancients, and especially by the Egyptians, who were accomplished astronomers. Sirius is the star which for long ages has been thought to be related to cometary visitations of the tandem or double variety.

numerous earthquakes and the appearance of islands which gradually subsided under the waves.

67. With few exceptions such islands rarely survive the disintegrating forces of ocean currents and weather, although the little island called Isola Nuova which came into existence in the Ægean Sea, off Santorin in 1823, a compact mass of basalt, has survived. One of the most remarkable areas producing such isles is that of the Azores, lying almost in the centre of the Atlantic Ocean. This group of islands, entirely volcanic, frequently subject to earthquakes and eruptions, possesses several rugged and precipitous cones, including El Pico, San Miguel, La Fayal and San Giorgio, al of which display intermittent activity. An eruption of San Miguel was recorded in 1638, another in 1691, and in 1720 a further eruption which produced a volcanic island six miles in circumference. In 1811 another island, named Sabrina, occurred during a volcanic eruption, which burnt furiously for a few days and then subsided. Its presence is now only preserved by a shoal some fathoms under water.

68. The phenomena of San Miguel of 1811 was interesting. At the latter end of 1810 severe earthquake shocks were experienced which sent a *solfatara* into eruption. This *solfatara* possesses hot springs, and emanations of sulphuretted hydrogen rise from divers parts of the island. In February, 1811, two miles from the coast, arose this volcanic island called Sabrina which rapidly

dispersed, and on June 13th, the same year, another island suddenly appeared two and a half miles beyond the first, containing a crater 500 feet in diameter and 300 feet above sea level. It also disintegrated into a shoal or reef of volcanic rocks. The eruption of 1638, already mentioned, also gave birth to an isle, but 200 years later its skeleton had sunk to such a depth that eighty fathoms of water lay between it and the surface of the sea. The succession of two islands in close period of time is a further instance of the attractive qualities of any active volcanic cone towards a meteoric body if in passing it should be drawn to the earth.

69. In the summer of 1898, a cable-laying ship was trying to fish up a broken strand at a point above 500 miles north of the Azores, at a depth of about 1,700 fathoms. The grappling-irons drew up soil and broken pieces of rock, which established the fact, it is said, that the bottom of the sea at this latitude presents the characteristics of a mountainous country with deep valleys. The grappling irons also drew up coarse striæ and small mineral splinters, and a vitreous lava or trachyte. M. Termier * contended that lava could only remain vitreous when it congealed in the open air and became crystallised when cooled under a mass

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* Paul Termier, Director of Science of the Geological Chart of France, in a paper entitled "Atlantis," read before the Institut Oceanographique of Paris on November 30th, 1912.

of previously solidified rocks, and if formed under 3,000 metres of water it would have become crystallised. As it was vitreous he contended that proof was afforded of a former continent or land which had subsided by earthquakes. M. Termier may be perfectly correct in assuming that the Dolphin Ridge, north of the Azores, was once land, but his deductions from the discovery of vitreous lava seem to be based on false premises. Lava assumes vitreous or crystalline form by a variety of circumstances already discussed which have nothing to do with the pressure of water (35). The same objection applies to the assumption that because volcanic particles are discovered in the ocean there must have been volcanoes in eruption to produce them, for often volcanic phenomena are produced without any volcano. The same cause that creates these islands in the ocean and Mt. Jorullo, with its astonishing accompaniments on land, may and undoubtedly does disperse its residue along the bed of the ocean.

70. In the summer of 1894 an earthquake occurred in the neighbourhood of the Caspian Sea, and a small submarine volcano appeared which ejected mud and lava from a small crater less than 20 feet in diameter, but the peak by the next year was eight fathoms under water. Several islands have been created during the historical age in the Ægean, notably in the neighbourhood of Santorin, the ancient Therasia, which was in eruption in 1707. Near to it is a little isle called Kammeui, which

came into existence first in 1573 and in 1707 was enlarged by an eruption of the same mountain. There are also several instances of islands appearing in the Sicilian Seas, but they have gradually disappeared. There is reason to believe that Lundy Island, off the coast of Devon, is a volcanic island dumped down a considerable period ago on that spot. Its vast granite blocks and some millstone grit, a stone underlying the coal measures of South Wales, added to its great chasms on the eastern side called " earthquakes " by the islanders, give the appearance of an ancient volcano now disintegrated.

71. It would unnecessarily swell this work without adding anything of considerable value were a complete list to be given of all the volcanic islands which have suddenly emerged above the sea level. It is, as the evidence proves, in the case of the island off Saigon (5), and the isles " thrown up " by the Tokio earthquake (12B), still a phenomenon associated with seismic and volcanic forces. Sometimes, as shown, there is all the evidence of volcanic activity in the shape of a tidal wave or waterspouts, discolourment of the sea in the vicinity, but no island, in which class we may legitimately place the Atlantic hurricane of September 1st, 1924 (9 *et seq.*) ; sometimes, as the accompaniment of an earthquake or volcanic eruption or both, a new island is born, but quickly disintegrates, even though of biggish size like that coincident with the eruption of Skapta Jokul in

1783; sometimes the island succeeds in establishing itself and becomes a permanent feature of the landscape. It all depends upon the physical conditions of the region in which it falls, and also, of course, upon the relative size of the meteor.

Volcanic Islands are Meteoric Bodies

72. This last class requires a little further consideration. When we glance at the vast number of volcanic islands with cones spread about the world, is it not a clear inference that they came there in exactly the same way as the minor examples cited? Do not Etna and Vesuvius, the Peak of Teneriffe, the great cluster of terrible volcanoes in Iceland, Stromboli, Ischia Island, Bandaisan and Fujiyama in Japan, and literally hundreds of other volcanic cones in the Atlantic and Pacific and Indian Oceans, owe their existence to exactly the same cause? It is true that we know of no records of any volcanic mountains created within the historical age to equal Etna or even Stromboli in size, for though it might be said that the creation of Jorullo was a modern example of a considerable erection, when millions of tons of liquid rock were suddenly deposited on a plain, yet Jorullo according to Von Humboldt was only 1,700 feet in height at the time (or, perhaps, 2,200 feet including the plateau then formed), but if all this weight of molten rock had fallen into the Pacific, which descends in parts to a depth of nearly 32,000 feet, or the Atlantic, over 27,000 feet, what would have

been the result ? There would have been a hurricane, an earthquake, a tidal wave, a roaring of the sea, a discoloration of the water, and that is all ! It is possible that the Tokio earthquake of 1923 deposited a greater amount of materia than Jorullo, which could be ascertained if the exact area and soundings were known. Assuming the height of Jorullo to have been what Von Humboldt allows (2,200 feet) it would have been insufficient to create an island even had it fallen on the Faraday Hills in the Atlantic, along the Dolphin Divide, midway between Iceland and the Azores, for the Faraday Hills, far the most elevated feature of this plateau, are yet 625 fathoms or 3,750 feet below the sea level. A consideration of these depths serves to show how unlikely it would be that a very considerable body, plunging into the basin of the Atlantic Ocean, would give any tangible results other than the utter destruction of any shipping at the place of impact, a tidal wave, earthquakes in any land area within its direction of flight, a hurricane and general disturbance of the atmosphere more or less prolonged and widely spread.

73. Jorullo also serves to demonstrate how meteoric islands may survive permanently in suitable sites, *i.e.*, where the sea is comparatively shallow, and also if the sea bed is already solid enough to provide a foundation. Jorullo, as mentioned (58A), was deposited upon a basis of black clay, augite crystals, and concentric balls of basalt, and as the clay gradually was dispersed by the

various currents, the new island, on such a basis, would have necessarily sunk until its foundation became the rocks. In this connection we should also take into account the solid sheets of basalt assumed to be lava ejections from a volcanic cone, such as the Etna examples of fourteen miles long and six wide (40), and Skapta Jokul, ninety-four miles by fifty miles, or the vast deposits Geikie mentions in the British Isles (43). What limits can we set to such a possibility, and is it not a likely hypothesis that on such a foundation the residue of a meteor could be firmly established ?

Geological Epochs and Meteor Falls

74. It is an indisputable fact that we do not witness in the present age, or in any preceding age, save a period mentioned in the Bible, and in the ancient classic myths of the destruction of the Titans or Gigantes, any volcanic phenomena on such a stupendous scale as must have witnessed the birth of Somma and Etna, to say nothing of that vast line of the Cordilleras, together with dozens of other volcanoes living, in a state of suspended animation, or dead, like the extinct craters of the Auvergne region, whose original vastness we can perceive. It is true that scarcely a year passes but we experience a catastrophe of some magnitude in the sense that thousands of lives may be lost and millions of pounds of property be destroyed, and yet these are merely trivial incidents in the great scheme of the Infinite.

75. Geologists recognise epochs when changes took place of such magnitude that they dwarf the imagination, and it must appear that then arose most of those volcanoes lying in the Northern Hemisphere, with their linear features directed towards the North Pole, or perhaps of a period yet earlier when the North Pole lay about thirty degrees south-east of the present. Geologists all agree that the termination of the later Tertiary Age witnessed one of these startling and revolutionary changes on the face of the earth, and I submit that the occasion of such a change and of all the sudden geological ages was due to the fall of enormous bodies of meteors, or, perhaps, to the earth's appulsion with a great solid body falling through space, and that such a body or collection of bodies came from the direction of the present north-east, fell mainly upon a certain portion of the Northern Hemisphere, occasioned vast earthquakes, and deposited not only certain mountain ranges but also volcanoes, causing among other matters the sinking of some lands and the uprising of others.

76. One reason why the volcanic mountains may be identified as originally meteoric deposits is sustained in a consideration of their craters. We find in the case of Jorullo that the thousands of little volcanic hillocks possessed flattened and, for their small size, proportionately big craters, and if the evidence thus far adduced supports the contention that Jorullo was thrown down in the form reported from the skies, the craters of such pheno-

mena are large in proportion to their size.* We find the same principle throughout all the important and ancient volcanoes, namely, that their craters were originally infinitely greater than at present occurs, and we can retrace the form of these circular or sometimes oblong craters, by their lips or steep cliffs yet surviving on the south or south-west sides. Imagine what a spectacle Tahiti must have presented with a yawning crater twenty-five miles in diameter! Mt. Somma had an enormous crater with lakes and forests whose ruins yet remain, the ancient craters of the Campi Phlegræi were tremendous, Lake Avernus being one such. Etna, with her Val del Bove, displays a crater once five miles in diameter, Réunion with the relics of a vast orifice, Teneriffe, and as far as I can ascertain without an exception we have to postulate a period when such meteoric mountains with huge craters fell to earth and burnt themselves out in most cases quickly, for the greater the orifice the sooner the activity lapses, although in others kept alive by special circumstances.

THE LINEAR SYSTEM AND THE POLE OF THE ECLIPTIC

77. In the various phenomena so far considered in regard to a volcano the strongest reasons have

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* To put the reverse side of the case, if the natural craters are such as we see in proportion to existing volcanic mountains, the later craters represent comparatively small meteoric impacts upon the former orifice which had previously been sealed by lava.

been presented to show that they are themselves meteoric dumps, and that eruptions of magnitude are due to meteor impact, while minor eruptions are caused by the gases of a meteoric body which may be drawn or attracted to the orifice of a volcano although the meteor may either pass on and not strike the earth or fall some distance away from the objective. If this be the case the significance of the linear placing of volcanoes in the Northern Hemisphere must not be lost sight of. It is a striking fact, but nevertheless a true one, that we can practically limit the lines of longitude concerned with the volcanoes of the present northern system (if I may so term it) as lying within an area of 240 degrees out of 360 degrees. The system—although actually inclined some 10 to 12 degrees east of the North Pole—stretches roughly from 20 degrees east of Greenwich, and *westwards* to 140 degrees east, or from Spitzbergen to Japan (196). In other words, China, Siberia, Russia and Eastern Europe are outside the area, and the volcanoes in the East Indian Archipelago belong to another system. If this indication proves anything it is that the events which brought all or many of the northern system of volcanoes into existence, did not touch China, Siberia, or Russia, or affect them in any way except climatically.

78. A change in the world's climate would necessarily be one of the lasting effects of such a period of activity as these strings of volcanoes indicate. We cannot begin to estimate how great a

quantity of solid land was added to the earth over those 240 degrees, for, while we may trace some of the chains of longitude they can only exist, or their vestiges, where the land still defies the ocean. Of the vast deposits which fell into the oceans and seas without establishing new land areas we can know little, but the effect of such an addition to the earth's weight, and that mainly in one hemisphere and over a portion of that hemisphere, would operate in three ways. In the first place it would shift the earth's axis, and consequently the Poles would move to the new points to correspond with the readjustment of the additional burden ; secondly, so unequal a distribution would require to adjust itself in regard to the inclination of the earth in relation to its axis so that its obliquity would be increased in proportion to its inequality of balance like an ill-weighted peg-top, and as every schoolboy knows, the earth to-day is inclined away 23° 27′ 14″ from the Pole of the Ecliptic, so that its Poles stretch down 23° 27′ 14″ accordingly ; and, thirdly, the law of gravity would demand that its annual rotation round the sun should compensate for this added weight. As to the first the Poles have shifted from a direction which I fancy lay before somewhere about the neighbourhood of Kamschatka ; the Arctic circles have increased their areas considerably as a result of the added obliquity as we know from many indications ; and as to the earth's orbit we have, since civilised man lived on the earth and possessed the calendar, added five days to the year. Formerly the year consisted of 360 days, now it is 365 days odd, and if any one estimating the total weight of our globe takes one-seventy-third of it he will be perhaps able to ascertain the added weight of this enormous series of deposits belonging to the last or Tertiary Stage of the world's existence.

79. These events in the world's history were the logical and inevitable outcome of a collision with a heavenly body or collection of bodies at a given period, say, in the closing moments of the Tertiary Age, or, as some say, Quaternary, when the mammoth yet roamed the wilds of Siberia and was engulfed in the vast area of snow and ice that resulted in places formerly moist and warm. This possibility of an appulsion is one to be considered more closely presently in an examination of the composition and movements of cometary bodies, but assuming for the present that such were the media we can obtain a most important clue from volcanoes. We see them following definite directions evidently of longitude from the region of the Magnetic Pole, or from the Pole of the Ecliptic. We see mountain ranges obeying a great predetermined law. We see that meteors, except for a few stragglers perhaps, pass us from this same direction, north or north-east. And whilst everything changes, the Poles, climate, earth's orbit, and whilst volcanoes undergo their birth, existence and extinction, only One remains constant and unchanging, as far as the finite mind of

man can conceive, that Centre of the Universe, the point we express as the Pole of the Ecliptic, the North Pole of the sun. As Schiller nobly expresses it,

> While man's will wavers,
> And in eternal movement all things circle round,
> One Tranquil Spirit remains firm in the midst.
> The loftiest Living Mind,
> Soaring high o'er time and space,
> One God, one Holy Living Will.

CHAPTER VI

THE FUNCTIONS OF A VOLCANO

CREATION OF SPECIES AND THE VOLCANO

WE speak of "Mother Earth," and throughout the ages we have regarded man and all living entities, whether of the animal, bird, fish, or vegetable kingdoms, as owing their origin to the dust of the earth. We are taught that man was created in the image of God with the dust of the Adamâh, whence arose the race of Adam; we talk of "human clay," and when at length we die we are described as having come from the dust and to dust we return. We find the same principle enunciated among the past and present races of the world. In his "Atlantis" Plato tells how Poseidon the earthquake or meteor god, associated with the sea, created Atlantis and gave it to Atlas, and this Mount Atlas, a volcano, was the father of the race of Atlanteans from whom, amongst others, the Greeks were descended. There was Mt. Prometheus, so sacred to the former race of men, also a volcano (94, 95), and hardened lumps of clay, preserved in an Arcadian temple, were shown to Pausanias, the historian, as remnants employed by "Father Prometheus" in moulding man. We find Hesiod describing the five creations of man, the fifth being the Iron Race, a system of philosophy in which Herodotus for one evidently concurred.

80A. The Greeks regarded Hera, the Earth, as the Mother of All, and the Babylonians in the goddess Ishtar worshipped the same deity, who in the Flood episode is supposed to have said, " I gave birth to man, and like fishes they are filling the sea." The goddess Astarte was held by the Phœnicians to have been the mother of their race, and to have fallen where the city of Tyre was built, and to have had several sons (or communities) by Saturn. The Aztecs of Mexico taught that men were created of ashes, red earth, the dust, and the bone of Michtlan Teuchli, the meteor god. The Codex Chimalpopoca of the Mexicans says that at the end of the fourth age of man, the mountains sank into the seas, all mankind was drowned, and Tezcatlipoca, the god represented as a smoking mountain, turned men into fishes. The Quiches of Guatemala, in their sacred record " The Popul Vuh," described how Cuculcan, a great serpent on the waters, and Hurakan (our word hurricane) created all life. The Brahmins of India believe that the god Siva created the first man, Adhieva, from fire. The Polynesians hold that man was created from red earth and the natives of Madagascar that they were the dust of the earth. These are only a few instances taken from many among the various races of mankind, and they point to a belief that meteors and volcanoes were concerned in the creation of life. Sometimes the volcano assumes the masculine gender, or a hermaphrodite, more often as Hera or as Ge, or as Ishtar, or as Astarte, or as Isis, the cow-mother, the earliest conception, with innumerable teats, or as Demeter or Persephone, it was depicted as a goddess of the underworld.

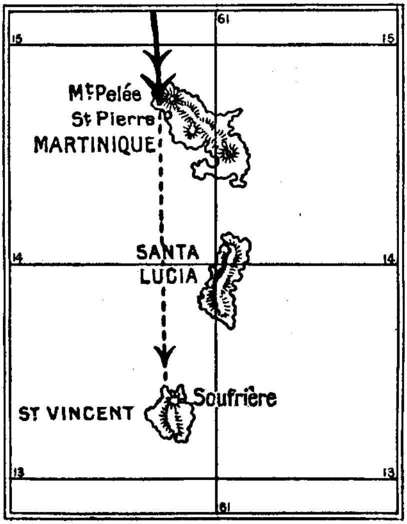
VOLCANIC FERTILITY

81. I have spoken already of the volcano as the female element in the great scheme of the Cosmos, and we discover it as the receptive organ which conceives and brings forth, gives birth to various conglomerate rocks after contact with the heavenly fires of the male gender, the meteor. An ascertained fact that cannot be denied is the fertility of a volcanic area. In spite of the dangers of eruptions peasants hasten to acquire land in the vicinity of volcanoes because of the extraordinary fertility of the soil. A case in point, illustrating the fertility of volcanic deposits, occurred in Lancerote, one of the Canary Isles, in 1730. That eruption, lasting three years, from numerous parasitical cones, buried the island under showers of scoriæ and ashes. The affrighted inhabitants had fled for safety to the neighbouring isle of Fuertaventura, and when they returned they found a soil far richer than when they had left it, and were able to cultivate the vine, which previously had not taken favourably to the soil.

82. A number of extinct craters or craters in a state of *solfatara* gradually form lakes, to which the formation of the crater, consisting of a circular or oblong elliptical cavity surrounded by the steep walls, offers favourable circumstances, like a saucer or cup whose lips collect and pour down the rain-water that falls. Many of these crateral lakes are very deep and extensive in size. In San Miguel, Azores, is a basin of this nature, fifteen miles in diameter, occupied by two such lakes. Monte Somma, as mentioned previously, had such a lake until the eruption of 1538 destroyed it (48). The dust and ashes, the pulverised ejections of the volcano, as it gradually seals up, form a clay or paste on mixture with water and form an impervious coating to the interior of the basin, while in addition various acid or saline vapours percolate through the pores and crevices into such lakes. These lakes, as they gradually increase in depth and volume, overflow when they overcome any point of resistance and become mountain torrents carrying the mass of loose substances through which they have forced a channel, thus producing alluvial (or eluvial) formations of considerable volume and properties. Sometimes these lakes burst, caused by a fresh eruption, which may proceed from within the basin, and such an eruption will proceed in the first place to eject quantities of boiling mud, and are commonly called mud eruptions.

THE VOLCANO AS THE MOTHER OF LIFE

83. Such eruptions, where the premonitory symptoms are the expulsion of burning mud, indicate that the crater was occupied by a lake and had been opened up by a meteor impact. It explains the phenomena attending the Mont Pelée eruption of 1902, to which I have already had occasion to refer. One of the first symptoms of its *first* eruption on this occasion was a shower of boiling mud and ashes, and when it is considered what fundamental possibilities exist in such volcanic alluvium, containing acids, salines, chemical properties of various values, minerals, gases of many qualities and electricity, can it not be discerned that amid circumstances and conditions in the atmosphere we may only faintly imagine, there do not exist the real agency of the origin of organic life ? Scrope, in reference to these lakes, says :



Map of the Martinique disaster. Mt. Pelée, St. Pierre and Mt. Soufrière, St. Vincent, being in direct line N—S. The point of impact was Mt. Pelée, blown to pieces, and the Bay of St. Piérre, due S. (See p. 27.)

Vast numbers of fish are occasionally found enclosed in the matter of these torrents. These have obviously been the inhabitants of the crateral lakes, the bursting of which occasioned those deluges; which are always preceded, and of course caused, by violent earthquakes.*

83A. How is it that fish came into existence in these lakes when, as often happens, no human beings have been in the vicinity? The same applies to vegetable remains. The alluvia of these mud eruptions yield traces of organic existence in the shape of fishes and various flora. It will probably be understood one day that there is a considerable connection between volcanic eruptions in certain circumstances and locusts in flight. These mud ejections, containing all the elements of life, "the dust of the Adamâh," may prove to have been that first divine spark from whence organic life is derived. Hence, in this case, it can be said that evolution was dependent upon the original chemical materia employed, as also upon the gaseous vapours of an atmosphere perhaps very highly surcharged with electricity and suited to the creation of life. To the womb of Mother Earth it may truly be said do we owe the organic existence in the first place of all forms of independent organisms, when that womb has been fructified by contact with the heavenly fires. Yet, if this be indeed the case, it may truly be said that every plant, insect, fish, reptile, crustacean, bird, beast and man has been transferred from, or is the evolution of, a similar entity from other worlds, evolved as the result of meteor impact and shaped in accordance with the chemical and gaseous formulæ of which the living unit in varying circumstances and ages is the product.

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* Scrope on "Volcanoes," p. 168.

84. Scrope (who, although his work on volcanoes was written 100 years ago, gave greater consideration to the minute details of volcanic phenomena than has any subsequent authority) says that Algæ and other water plants grow within these lakes, probably forming the carbonaceous matter which so remarkably characterises mud eruptions, and he draws attention to the variety of these deposits due to the different mineral qualities of the pulverised lavas or paste. To this cause he attributes the trass of various parts of Europe, in the Andernach district of the Rhine, in Eiffel in Rhenish Prussia (once highly volcanic areas); the tufas and breccias of Mt. Dore, Cantal, and Mezen, in the Auvergne; of the Campi Phlegræi and Ischia; and in all probability in Hungary. The trass of the Rhine district is remarkable for enveloping a great quantity of vegetable remains, always carbonised, and occasionally turned into jet.

VOLCANIC LAKES

85. A great many circular or oblong lakes, so commonly met with in volcanic districts, as in the west of Italy, Central France, and the left bank of the Rhine, are thought to be the decayed remains

of volcanic craters. In Italy we discover such well-known examples as Lake Ronciglione, which retains the remains of a cone in its interior, Lake Albano, a few miles from Rome, the lips of whose ancient crater envelop it in steep escarpments, particularly to the west, south and south-west, and in the case of Lake Avernus, on which is largely superimposed Monte Nuova (48). It seems to be established that volcanoes are sometimes entirely destroyed by a so-called eruption which drives the remains of the mountain underground or shatters it into fragments, leaving a cavity that becomes a lake. In 1638, a colossal cone called the Peak, in the island of Timor, one of the Molucca Islands, was blown up and replaced by a cavity that formed a lake. In 1693 the island of Sorea, another of the Moluccas, suddenly disappeared, during an eruption, with a violent explosion. In 1718 St. Vincent was shaken by a violent earthquake, the volcano ejected clouds of ashes miles in the air, and amid loud detonations, the volcano at the east end of the island completely disappeared, leaving a lake. In 1883, Krakatoa, between Java and Sumatra, a former landmark for mariners, was supposed to have been blown into fine dust by its eruption, but a great blue meteor was seen in the Straits of Sunda beforehand. As a sidelight on the cause of such catastrophes may be mentioned the eruption of Mt. Bandaisan, in Japan, in 1889. One-third of the mountain was supposed to have been flung to a spot four miles distant to the south and to have buried itself in the soil. The volcano was choked with great rocks and ejected vast quantities of burning sand, turning day into night, while the sand burned a great number of people to death. There can be little doubt that a meteor choked up the volcano, and falling, as frequently, in more than one dump, its residue plunged into the soil four miles beyond.

85A. These instances serve to illustrate the presence of many of these circular or oblong lakes, but it does not invariably follow that the existence of the crater must necessarily be due to the presence of a former volcano on the spot, although undoubtedly the magnetic attraction of the volcano offers the target to the meteor. Yet, as has again and again been proved in the examples cited, the meteor fails to come into actual contact with the objective, or may only come into partial contact with it. In the Catania earthquake of 1811 a number of villages were crushed flat, and in their places appeared lakes containing petroleum and sulphur and sulphuric acid. The Charlestown earthquake, along the alluvial banks of the Mississippi River, New Madrid, lying to the south, produced a number of lakes, also a white phosphorescent powder and vaporous mists. It is in accordance with the laws of meteor impact that should meteors strike a rocky formation they open up cavities, but if the soil is alluvial, while they sink deep and leave their traces in cavities which also form lakes, these gradually close up, as appears to have been the case at Sedgemere in Somerset; the closed-up cavity of a meteor which left originally a lake of burning pitch, then became an inland sea or lake and is now alluvium (92, 92A). The underlying strata therefore plays a large part in the resultant effects. It must also be premised that as a general rule a meteor impact in alluvial soil which leaves no traces beyond a lake or lakes is comparatively of small size. In the New Madrid example it should be noted that Charlestown to the north, devastated by the earthquake, also experienced a fall of burning flints and a yellow, viscid substance like sulphur. The presence of these lakes in volcanic or so-called seismic regions is entirely inexplicable either as a volcanic eruption or as an earthquake. It can only be explained by the same originating cause of either or both, namely, the fall of a long, as it were, serpentine body which, if it strike a rocky foundation, may either form a cone (as in the case of Monte Rosso), lakes, or, if along a rocky coast, cause deep fiords, as in the case of Norway and the many singular examples of the Scottish lochs. One of the most remarkable illustrations in this way is to be found in the tattered Outer Hebrides, and especially in the case of the little island of Benbecula, at some former date literally bombarded with meteors, which have caused dozens of small circular and oblong lakes, as well as a succession of fiord-like inlets.

AREAS ELEVATED BY EARTHQUAKES

86. A good many references have been made in the preceding pages to earthquakes in relation to volcanic eruptions. Eruptions of any magnitude are invariably preceded by earthquakes of considerable violence and are more or less prolonged, and, as was also mentioned, on these occasions the atmosphere beforehand assumes an airless void, sultriness, and pressure, and the barometer falls ominously. The earthquake in its movement invariably pursues a direction from the north towards the south, and gives a sensation of a heaving or elevation of the ground in a series of vertical shocks. The antiquated idea that these shocks are caused by the forcible elevation of solid rocks by violent expansion of the lava flow beneath is inadmissible, because sometimes these shocks occur without any volcano being in the vicinity at all. The other idea that they are caused by a shrinking of the earth's crust is also based on the hypothesis of an inner nucleus gradually cooling, and is equally fallacious, for on such a reasoning the earth should be shrinking in size and gradually all parts should fall in, neither of which give the slightest evidence of existing. The earth's circumference is well known, and if this shrinking theory is worth anything we should be bound to find in the course of centuries some slight reduction, and we should discover areas suddenly collapsing enormous depths under the land level.

The contrary appears to be the case. *The earth is not shrinking, but is slowly and surely expanding. The earth's orbit is now 365¼ days, and even that odd quarter represents an accretion of materia during the historic period. The earth, in short, is slowly receding from the sun in accordance with the law of gravity because of its added weight.*

87. It is a usual occurrence on the other hand to discover earthquake areas elevated instead of depressed. Scrope mentions the Leeward Isles, Caracas and Venezuela, whose earthquakes are observed not only to produce numerous fissures or rents through the existing rocks, but to " elevate them perceptibly, at each successive shock, above their previous level." * Along very elevated heights of volcanic and seismic activity, as the Cordilleras, surveys show an increase in size rather than a decrease in spite of the erosion of the weather. This is probably accounted for by accretions as on the occasion of a severe earthquake in Lima in 1746, when no less than four volcanoes burst into eruption in one night, or as in the Chile earthquake of 1822, which was felt along the line of the Cordilleras for nearly 1,000 miles. All such occasions as are taken by the vulcanists to confirm their belief of the rupture of the solid overlying strata of the earth's crust by subterranean expansion, the production of a fissure and hence an earthquake, so that we must always expect earthquakes to occur in the vicinity of volcanoes, are

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* Scrope on " Volcanoes," p. 190.

refuted by the fact that they do not always have any appreciable effect on an adjoining volcano, and not infrequently occur where no volcanoes exist.

EARTHQUAKES NOT ORIGINATED BY ERUPTIONS

87A. As to the first, we have the recent outstanding example of the Tokio earthquake of September 1st, 1923, when Fujiyama, in the near vicinity, was unaffected, and yet should, by such reasoning, have burst into paroxysmal activity. No more dangerous earthquake centre in the world exists probably to-day than the area about Mt. Etna, which again and again has been shaken by prodigious earthquakes causing enormous loss of life and damage to property. In such disturbances, not once but many times, Messina and Reggio to the north, and Catania to the south, have been shaken to their foundations without a volcanic eruption, or, if one at all, as a latent and tardy effort which soon dispersed. Such an occasion arose in the famous earthquake of December 29th, 1908, when no less than 200,000 people were killed in Messina. The night was heavy and oppressive, when a few moments before 4.20 a.m. overhead rumblings were heard, and a brilliant stream of light was seen from Messina on the Calabrian side of the Straits, that is a little towards the north-east. The first shock lasted several seconds, crushed flat thousands of houses on both sides of the Strait, orange groves were destroyed, the trees were rooted up or crushed flat, and a considerable area along this direction was flooded. In Messina, the town, which I visited shortly after, looked as though it had sustained a tremendous bombardment. Houses and churches of solid stone were thrown down, scarcely a roof remained, and to add to the distress a tidal wave drew the sea away from the shores and quay and returning at an enormous height picked up shipping like toy boats, dashed some ships against the big, solid buildings on the quay, and carried others right over them into back parts of the town. This event not only occasioned a tidal wave, but was accompanied by tremendous rain. Stromboli—not Etna—burst into slight eruption, and that is all! On this occasion, as reported, the meteor was seen coming from the Calabrian direction, and it did not throw Etna into eruption because it fell short, in the sea, whence arose the tidal wave. This earthquake, compared with that of Tokio, or the smaller event of Amalfi (6), presents identical phenomena. The explanation of the Messina earthquake is that a meteor, attracted to Etna, plunged in the sea north of the Straits and caused the quakes, tidal wave, and resultant loss of life and damage along a definite meridian of north to south.

87B. As to the second, earthquakes occur within the longitudes Spitzbergen–Japan not infrequently without any volcano within the immediate region. One needs look no further afield than to the

British Isles, where over 200 earthquakes have been recorded since 1881, although minor ones, and of these four-fifths have taken place along the west coast, say 3° west of Greenwich, from Caithness to Devon. The volcanic centre in this area seems to be about the Brecon Beacons and the Mendip Hills, where in Bath, Bristol, and Wells hot springs testify to ancient activity, and at Sedgemere a *solfatara*. The Charlestown earthquake is also an event far removed from a volcano, for the nearest is over 600 miles away. The Lisbon earthquake of November 1st, 1755, is another. It was preceded by the usual phenomena. The first warning was so great an oppressiveness that people could scarcely breathe, and this was followed by a rumbling like distant thunder. The resultant shock threw down most of the city, then one of the finest in Europe, day was turned into black night owing to the thickness of the dust and the meteoric dust, and portions of the sea coast collapsed and fell into the sea. At the first threat of disaster thousands of panic-stricken persons rushed down to the new Lisbon Quay, built of marble, and others seized boats and rowed out into the Tagus, when suddenly quay, boats and people disappeared, a yawning bottomless chasm being left in their place. The Tagus, after forming a great waterspout 60 feet in height, returned and filled the cavity, while a big tidal wave flung itself upon the shores and extended as far as Kinsale Harbour, in Ireland, where it flowed into the market place and flung fishing boats inland. A feature of this catastrophe was that although some 60,000 perished on or near the quay or in boats, not a trace was afterwards found of a single body, boat, oar, or hat, while soundings of the chasm where formerly stood the New Marble Quay could not be plumbed by a line reaching to 400 fathoms (2,400 feet). It was mentioned previously (17) that this meteor impact coincided with the eruption of Kattlagia in Iceland, along the same meridian, and the demolishment of a town or village in the Atlas Mountains, the explanation offered of the latter being that an earthquake caused the earth to leap into the air, formed two mountains, and these fell on the town and buried it.

88. These two cases cited, of Messina, almost in the jaws of Mt. Etna, and Lisbon, far removed from any volcano, testify, as every other example produced, that while volcanic eruptions and earthquakes are part of the phenomena of meteoric falls, an eruption does not cause an earthquake (save a minor tremor), and an earthquake does not cause an eruption. A volcano attracts a meteor, and this heavenly body, on its near approach to earth, acts like a magnet upon that portion of the earth it rapidly traverses overhead, and hence occasions those vertical waves which rise and fall during the passage of the body and subsequent lesser shocks as the earth readjusts itself to the new conditions.

THERMAL SPRINGS

89. Another consideration in regard to volcanoes is that of hot or thermal springs. They require passing mention because their presence invariably denotes a volcano or a *solfatara*. It is generally agreed that the heated rocks and lava buried deep in the bowels of the earth form gaseous bubbles, sometimes very large, when they crystallise, and into these cavities or caverns the vapours escape through fissures in solid overlying rocks. Stalagmite caves, such as those at Cheddar in Somerset, and near Torquay in Devon, were of such origin, for limestone is a fused composition of sulphur and oxygen. In general, it seems, the aqueous vapour and various saline or mineral acids percolate through, forming in fact one or many subterranean lakes. After most eruptions a vast body of heated lava must remain beneath the bottom of the crater in which the process of solidification goes on slowly for an indefinite and often very long period, affording a continual source of aqueous vapour, charged more or less with various mineral substances.

90. These vapours, more or less condensed by refrigeration before they issue into the air, make their appearance in the shape of springs of water at a variety of elevated temperatures, occasionally even many degrees above boiling point. These hot springs are common in all volcanic districts, and where all external signs of a former volcano have

perhaps been obliterated are the only indications of the still remaining activity of the focus below. The water of these thermal springs holds in solution the various mineral substances, which, in the form of vapour, is carried from the yet heated lava below. Even when a thermal spring no longer retains any heat and flows from rocks presenting no indication of recent volcanic action there is still every reason to believe them to have had the same origin, as in the case of the Malvern waters, Harrogate waters, Tunbridge Wells, Bath, and others. On the other hand, where the lava is intensely heated and very near to the surface, intermittent fountains are sometimes produced as the Hot Geysers of Iceland.

91. Generally speaking the lava gradually cools, even though it be a case of centuries, an example being in the case of Jorullo in Mexico. The lava plateau fell on two rivers which gradually found a bed through the mass of intumescence and came out the other side at a very high temperature. A hundred years later they were scarcely more than tepid, and to-day yield no evidence of heat. However, streams passing under or through a rapidly cooling mass of lava are not the same as subterranean lava-formed lakes buried deep under the earth. At Bertrich-bad, Luxembourg, for example, the thermal spring keeps up a temperature almost at blood-heat, and it rises immediately below a spot on which three volcanic vents were formed long before any date of which we have knowledge.

Another such site of hot springs are the famous waters of Bath, and there are, in addition, many thermal or mineral springs of volcanic origin in South Wales, all part of one considerable event at some past epoch.

92. Bath is perhaps the most fascinating region on the face of the earth to any student of physical geography and also of ethnology. It is built itself on the vestiges of a vast and ancient volcano and this, in turn, is surrounded by, or closely approached by other former volcanic cones, such as Solsbury, to the north-east, while the crags of Beechen Cliff and Lansdown Hill probably mark the lip of an ancient crater. The two different geological formations of Bath point to the superimposed strata upon an earlier one. At about the time of the Carboniferous Period, the whole of the area of the Mendips to the south is said to have been submerged, and 6,000 feet or more of solid rock was driven into the earth. At any rate, by some great volcanic upheaval, the carboniferous limestone, with which the Bath waters are so strongly impregnated, came into existence, and the hidden source is supposed to be at Churchill Batch and Dodbury, along the Mendips.

92A. The waters contain lead, zinc, iron and manganese, all of which occur in carboniferous limestone, and sometimes the waters are found to contain in minute fragments fossils, coral and bivalve shells, thus pointing to the undoubted fact of this concealed lake as being in contiguity to an ancient sea bed where coral existed. This again suggests that a considerable meteoric body was deposited upon a sea of the Primary, Secondary, or early Tertiary Period, since when, it would seem by some means that as yet defy solution, the caloric has been retained. It must have covered an extensive area because Bath, Wells, and Bristol are all supplied by these thermal waters, and apparently this has been the case for thousands of years. The King's Bath is traditionally credited to King Bladud, which would place it many centuries before the Christian Era, and sometimes the water shows on the surface gases that burn with a blue flame. Queen Anne, when she bathed there is said to have seen this blue, incandescent gas, a not unusual phenomena of volcanic hot springs, and of sulphurous origin. It is also witnessed in the South Wales coalfield, where firedamp and explosions are of common occurrence.

THE ATLANTIS MYTH AND BATH

93. It may, perhaps, not be out of place to mention here that Bath and her environs would seem in many ways to correspond to the ancient capital of Atlantis, described by Plato, but not mentioned by name, although he does allude to Gades or Tartessus, often associated with the cult of the Underworld. Gades, it is true, is commonly identified with the modern Cadiz in Spain, but there are many geographical references to

Gades or Gaddir, which seem to place it originally in the British Isles, and one other important piece of testimony, namely, that Gades lay in the centre of the tin-mining industry, and the only region that answers to this purpose is Cornwall, Devon, and Somerset. Tin was largely mined (as also lead) from the Mendips, whereas there is no tin in Spain, or indeed elsewhere in Europe. The importance of the Atlantean legend is the very clear significance that the capital was built around and upon a volcano, as is Bath ; it had seven hills round which the river or canals wound, as also has Bath ; it was famed for the delightful variegated stones and for the various metals, gold, silver, lead, tin, copper, etc., and in the Mendips and Quantocks are or were such stones, and all these metals as also sulphide of zinc mixed with copper to make brass ; it was famed for its hot baths, made by the earthquake god Poseidon, and again we find these. The story told by Plato was that in this island of Atlantis, blessed by a glorious climate, and producing everything for the good of man, arose the great race from whom the Athenians were descended, and that the island and all dwelling on it were destroyed by a tremendous catastrophe which caused evidently enormous earthquakes and floods, and left behind only the skeleton as it were of its former greatness. That some such catastrophe did afflict the British Isles is proved by geology, and it would appear to correspond with what is termed the Drift Age. That this event (the Drift) could be related to the destruction of Atlantis is not a possibility geologists would admit, for they give the Drift (or Ice) Age anything in the way of antiquity from 100,000 years upwards. On the other hand, if the meteoric theory be correct all these estimates of geologists, based as they must be, on false reasoning, are wrong. Scholars who seek for Atlantis in the Canary Islands or the Antilles, or along the Dolphin Ridge might profitably turn their attention to the British Isles.

PROMETHEUS, A VOLCANO, DESTROYED BY A METEOR

94. Another very important classical reference to volcanoes and meteors is contained in the myth of Prometheus. When the myth is understood to relate to a volcano everything in an otherwise meaningless anthology is comprehended. First of all, Prometheus had a quarrel with Zeus, because in the division of the sacrifices the god of Olympus was given the worst part of the offering, which shows that in an early day the fire-worship of the volcano was held to be of equal importance, if not more so than that of Zeus himself. The manufacture of Pandora by Prometheus has nothing to do with this matter, but it suggests that Prometheus was regarded as the creative deity, as he was, creating man out of clay, says the myth. At this juncture Zeus, who was angry with mankind, resolved to destroy the human race by with-

holding fire and warmth from man and the world was in peril of dying of cold. Prometheus—" the saviour of mankind " Æschylus terms him—saved the human race by stealing and bringing down fire from heaven in the hollow of a giant funnel. Because, continues the myth, he saved mankind from total extinction Zeus, in his anger, chained him to a rock on Mt. Caucasus where a ravenous eagle tore his liver daily.

95. The reading of the myth, it would seem, is that the world was believed to be in danger of a great catastrophe which would destroy all human life and inaugurate a new Ice Age. This volcano burst into paroxysmal eruption and the fire stolen from heaven was the meteor impact in its visible effects, a great pillar of gas, ashes, dust, and lightning, spreading in the heavens like a gigantic red-grey flower (the fennel) on a stalk (31), chained to a rock signifies that rocks fell, and the liver being torn every day by a ravenous eagle is a poetic reference to the ejection of lava. In the moving tragedy of Prometheus, Æschylus depicts the god as having been sacrificed willingly to save mankind from " sinking to the realms of night," and his sufferings, " dreadful to behold," are described, as the " Saviour of man " is nailed to the rock, hanged, with arms outstretched in the shape of a cross. The Caucasian Jupiter was depicted on ancient coins as a volcano, but I should also be inclined to search for the remains of such a volcano within the Atlantic zone instead of the

Caucasus Mountains. At a very early date a tremendous volcano evidently existed in Ireland, somewhere off the mouth of the Ovoca River in Co. Wicklow, where, as legend says, the first immigrants settled, and these people called variously Nemedians, Partholan's People, and Fir-Bolg, were given the Gaelic names of " Corca Oidce," " Corca Duibne," and " Hi Dorchaide," (later Cauci, the founders of the city of Cork), meaning " The People of the Night Country," and names referring to their original country. The same people seem to have been Iberians or Scythians, and hence it is that Mt. Prometheus, whose story is depicted on the façade of Bordeaux Cathedral, is variously described as in Scythia, Iberia, and the Caucasus. The fate of Mt. Atlas and of Mt. Prometheus was similar. They were ultimately destroyed, smashed and driven into the earth, by the fires from heaven.

96. One other aspect of Prometheus requires consideration. Deucalion, the Greek Noah, was warned by Prometheus that Zeus intended to drown the world, and so he set out to build the ark whereby he and his wife Pyrrha and their families escaped. The name of Prometheus (" Forethought ") indicates the warning which Deucalion received. The mountain apparently burst into a preliminary paroxysm like Mt. Pelée in 1902, and Deucalion prepared for emergencies. These legends serve to show that the ancients held views regarding volcanoes that agree with the con-

tentions put forward in this work. They thought volcanoes were the saviours of mankind, and that they acted as protectors of humanity. They were afraid, when a premonitory eruption took place, that there might be worse to follow. They regarded the volcano as the source of creation, and yet they accorded to Zeus, the thunderbolt, the meteor, the power to do as he willed with Prometheus or Atlas, afterwards destroyed by Saturn. If this allocation of the situation of Mt. Prometheus be correct it will be understood how violently the British Islands must have suffered in past times. The presence of a volcano brings fertility and wealth, but it also offers a constant and dangerous menace, and it is fortunate at least for the security of the British Islands that the source of attraction has moved elsewhere, and that any former volcano has been destroyed or driven into the earth, as, it was suggested previously, may have been the case in Lundy Island, in the volcanic remains in Southern Wales and on Dartmoor in Devon, and in certain spots in Somerset.

CHAPTER VII

VOLCANIC DEPENDENCE UPON METEORS

ORIGIN OF EARLY NATURE WORSHIP

THE function of a volcano is to produce. It obeys, as has been observed before, the laws of sex, inasmuch as it is the receptive agency, the female principle ; indeed, upon consideration, the orifice, of circular or elliptical form, follows the principle of the vagina and uterus, as the meteor takes the shape of the upright pillar. It will be necessary in tracing this aspect of Nature to the earliest human knowledge on this vital matter to show that such was the belief of the ancients. It is the secret of serpent worship, and was the origin of the Phallic cult, upon which it throws an entirely new light. Phallic worship, which has seemed so gross to many, was not due to the ignorance of the patriarchs or of the philosophers of old time, as should be recognised, seeing that Solomon, accounted the wisest of men, adorned the Temple at Jerusalem with phallic emblems, traced also upon the garments of the priests. To illustrate this fallacy a short quotation from the authority on this subject, General Forlong, whose erudite but misleading work " The Rivers of Life " first drew attention to the subject, may be given here :

> Early man was . . . a mere child of sensual passions, whose supreme bliss and misery we can easily gauge if we will but try to carry our mind's eye back through the dark vistas of time and so realise the feeble and comparatively helpless condition of our own infant race in its primordial state. In those early days all that is noblest in our character lay dormant, and the creature, a mere animal, roamed naked through primeval forests, with no food save fruits and roots, no shelter from storms and cold save rocks and caves, and a prey of all those fierce animals which geology proves then traversed all earth, terrible in size, number and ferocity.

98. Accordingly, therefore, we are to believe, primordial man worshipped the organs of reproduction, which is the whole theory of the Phallic school. Why, in such case, have not ethnologists discovered the same principle among the savage and primordial races of the equator ? The evidence is quite the other way. These treat sex problems very simply and without the slightest reverence, for the good reason that prudishness does not enter into their calculations, and their mentality, in regard to the real significance of the *linga-lingam* principle, is not on a sufficiently high plane to realise its significance. Those who knew and understood the science of these questions were the ancient Aryans, whose pillar-stones, sacred rocks which no chisel might profane, were anointed with oil, and whose altars and temples, like Avebury and Stonehenge, erected for astronomical purposes, were built of such meteoric stones. They knew, they understood, not because they were primordial, but because they had

delved farther into the scheme of the Infinite than some of our scientists of the present day. They worshipped Nature in the manner science must discover that Nature manifests itself, the meteor as the male, the volcano as the female, and the fruits of their unison being creation.

The Earth's Evolution and the Law of Magnetic Attraction

99. The function of a volcano is, I repeat, to produce. The evolution of the earth would appear to follow a system whereby at various periods great masses of molten rocks, stones, clay, sand, and chalk were deposited upon certain regions of the earth. Accepting the evidence of modern volcanic eruptions, following along the principle on a minor scale, such as Jorullo, Skapta Jokul, Vesuvius, Etna, and the Auvergne range, these deposits fell in the form of numberless volcanoes, some large, some small, and some where the main surviving nucleus would set up a considerable volcanic mountain or mountains, some of which survive in active form to this day. These nuclei or masses may probably be sought among the earlier formations in the volcanic systems of the Polynesian Isles, Sumatra, the Caucasus, Apennines and the Carpathians. The second system may be placed in Java, its meteoric nucleus attracted thither by Sumatra. A third system, from the north-east, may be traced, and the fourth, or last—the existing system—may be identified from the north. There are many subdivisions in each class.

100. The existence of a system, and in a minor degree of isolated volcanoes, has attracted other meteoric deposits. This law of magnetic attraction is emphasised frequently by overlapping mountain ranges, of transverse ranges crossing a pre-existent system and isolated vents like Etna, dotted round with satellites. Nowhere does this principle seem to be better attested than in France, where across a system stretching to the north-west from Mt. Lazare of very old rocks, *viâ* Mont Dore, and perhaps as far as La Souterraine, in the Creuse, three later parallel ranges were thrown down from the north and north-east, one the Cevennes, another the Auvergnes, with the Monts du Forez and the Velay, one a continuation of the other, in between. The Chaîne des Puys, in the Auvergnes, contains over sixty cones strung together along the same line, while the Velay and Vivarais (a continuation) have over 200 cones closely scattered upon a narrow band scarcely twenty miles in length. Among these are many examples of compound cones, where impacts occurred on the one spot, and sometimes, as the ejected lava shows, they were simultaneous. Throughout these periods where they clashed with pre-existing formations, evidently then active, can be distinguished strings of cones so close to one another as to confound their ejections. Nevertheless, once the order of direction is known, we can trace the ensuing falls, and we can see how those from the north have super-

imposed themselves upon pre-existing recumbent masses, forming a system east and west.

101. By this method of magnetic attraction were the land masses built up, for it must always be realised that while the nucleus would form an active volcano, large or small as the case might be, the remainder fell behind, or around, over a wide area. This is shown more clearly in a later chapter concerned with the composition of meteoric bodies. As a general rule it may, therefore, be laid down that the oldest lands betray extinct volcanoes and the younger ones, because laid down last, possess active ones. Yet this is not precisely correct, for the reason that any predominant volcanic mass or masses may survive in the oldest lands. It is the case in several of the Polynesian Islands, where volcanic activity was more pronounced formerly than anywhere else in the world. It is perceived in Java with her thirty-eight active volcanoes, and in Sumatra with at least four. It is seen in Kamschatka, in Mexico and in Italy, whose earliest rocks are primaries and secondaries. Nevertheless, as a general rule, it is true to state that the disintegrated masses of former volcanic systems are discovered in the oldest lands, and in such lands the active, life-bearing capacity has passed away, unless some latent attractive force, as perhaps in the case of Etna and Vesuvius, has operated even though a new system has come into being. The earlier and now mainly defunct systems can be

judged by their linear direction, and, though in some cases the original systems have been devastated by later ones, which makes it difficult to identify direction, the early laying down of lands may be traced along the west coast of North America, in part of the Himalayas, some of the Alps, the Hungarian Mass, part of the Auvergnes in France, and at least the Dartmoor cones in Devon (of which there are denuded specimens of over 40). These are, of course, only a few instances of many in the primary, secondary, and early Tertiary Ages, but all these have, so far as can be judged, long ago expired as active volcanic areas. The reason for their ultimate barrenness is in some cases undoubtedly due to the setting up of new and rival attractive forces elsewhere, as, for example, Iceland, which has doubtless acted as a lightning conductor to the British Isles, and also to the further fact that in course of time these volcanoes, like all else, must reach their allotted span and either die out or else be extinguished finally, as was Krakatoa or Mt. Atlas, or Mt. Prometheus, and numerous ancient and modern examples, by an impact which explodes and kills them.

VOLCANIC ACTIVITY DEPENDENT UPON METEOR IMPACT

102. Let us understand completely that a volcano when it is established is yet dependent upon intermittent contact with the generative

power in order to preserve its vitality. While it must be admitted that the subterranean agencies may be smouldering unseen for enormous periods, as in the case of the thermal streams of Bath, yet unless revitalised they must and do become extinct in course of time. The law is emphasised over and over again. We know the history of volcanoes that have gradually aged and retired, and of others which have suddenly appeared, burnt out, continued *in solfatara* for a period and then expired, like a woman who has passed her youth and is no longer capable of bearing offspring. It is this need, the essentiality of meteor visitation, which accounts for the eccentricity of a volcano's periods (29, 29A). And the opposite of this is equally true. Once a volcano has begun to display evidences of vitality, it is in a state of heat, and it becomes at once a focus of attraction to any passing meteor, which on such occasions seems to be drawn in by the magnetic and gaseous vapours emitted from the orifice (26C, 50, 61, 68). Thus it is we find many major eruptions have been preceded by a prior and minor eruption. This may have been caused in the first place by the absorption of meteoric fumes and gases left in the atmosphere by a body which may have passed close to the earth, but without striking it, or it may have been due to a small and minor impact. Yet it is when a volcano is in this state of activity that it becomes most dangerous, and people dwelling in towns and villages in its vicinity are well advised to clear away. This same lesson is conveyed in the legend of Prometheus, who forewarned Deucalion. It is, moreover, as we know, the law which prevails in the animal world, namely, that the periods of the female are those which attract the male of the species.

THE EARTH'S DEPENDENCE UPON VOLCANOES

103. The functions of a volcano are by no means confined to the actual eruption and gestatory periods, important though these be. Without volcanoes the earth would become an utter waste, with no life, no atmosphere, no waters or oceans. Such has become the fate of the moon, a planet consisting of enormous extinct volcanoes, but without atmosphere or oceans. A little reflection must show that the air we breathe requires frequent renovation, and to suppose that the oxygen we breathe to-day is the same air as existed æons ago is on the face of it absurd. Newton and others who considered this point opined that the tails of comets (cometary gases) drifted into our atmosphere and replenished it. This is possibly true, but we do not need to seek further than the penetration of meteors which it is proved bring with them gases, such as hydrogen, nitrogen, as well as others of a combustible nature. It is in this manner also that the seas and lakes and rivers are maintained, for, again, it would be impossible to assert that the same drops of water have survived, even in various vicissitudes, throughout all the ages. Indeed, we have in the

sun a potential force at work absorbing the watery molecules, whose radiation doubtless consumes millions of gallons in the course of a year. The accepted idea, namely, that the sun by radiation forms clouds of water drawn into the sky, which fall again as rain, seems to be a perversion of the facts due to a total ignorance of the factors that cause the water and the air. The incidence of any earthquake, eruption, or hurricane denotes plainly enough that new and violent currents of air have been projected into our system, and great quantities of water.

INCREASE OF WATER IN THE OCEANS

104. This water, the result of the introduction of hydrogen and nitrogen into our atmosphere, occasions many disasters of the first magnitude. I shall say no more at this moment of the Ice Age (or Ages), but geologists agree that it coincided with earthquakes and terrestrial changes on an enormous scale, which resulted in a tremendous flood. Earthquakes and terrestrial changes show from where the flood came. Again, in the Bible and the Greek legends of the Flood we discover vast earthquakes and burnings (like that of Sodom and Gomorrah), in which rocks and mountains fell on the giants, followed by a flood which covered all but the tops of the highest mountains. It must stand to reason that as the earth's bulk must gradually increase by the addition of meteoric bodies and the gases they bring, which condense into water or

air, except for such relief as is afforded by the sun's radiation, we must rather accumulate more water than less, whereas without such recruitment the ocean waters would gradually evaporate.

105. Here we reach a point of some significance. The evidence that exists from sea soundings, and almost from the observation of our eyes, points to greater sea depths. There is more water in the ocean basins and seas, with one or two exceptions, or more land in the ocean bed, than formerly. The newspapers in England have recently shown, if not alarm, at least some nervousness, regarding the serious erosion round the British coasts. Lowestoft complains that a sea wall is going, and a million tons of beach are gone. Along Yorkshire, Lincolnshire, Norfolk, and Suffolk important historical towns like Ravenspur and Dunwich have disappeared. It is the same thing, with one or two exceptions, along the south and west coasts, and it is claimed on reliable authority that the net losses in the land area of England now amount to a square mile per annum. Greenland is said to be diminishing rapidly. Heligoland is going and would have vanished before this had it not been artificially banked up. The position of the Polynesian Archipelagi is particularly instructive. If this were the ancient continent called by Haeckel Lemuria, and whose prior existence I advance on the evidence of volcanic chains and meteor flights (thus on an entirely independent basis), how is it that so great a land

has sunk into the ocean ? Earthquake shocks ? But do earthquakes swallow up lands ? Can any concrete example be advanced of an earthquake that has submerged any body of land ? There is no historical record of such. Atlantis ? It is certain that if this island existed, and so great a catastrophe as tradition relates did occur, the resultant effect would be a vast tidal wave or succession of waves, and the enormous increase in water could and probably would flood the land for a period. It is highly debatable, however, whether that or any other island was dragged down under the Ocean by seismic shocks, for until it can be proved to the contrary the indications refute the possibility of any land surface being shattered by any seismic violence.

106. It is not only possible, but probable, that the contrary action gave the same effect. If—as the Ice Age seems to suggest—vast volumes of water have been liberated periodically and have drowned lands, Atlantis was submerged as the British Isles have been, and eventually returned again as they have above the surface. In such circumstances large and low-lying tracts might never again appear above the surface, like the forest lands off Devon and the St. George's Channel, formerly little more than a wide river, while the ocean currents would wash away the more alluvial lands. When, too, the superabundant waters had gradually found their level, it still remains likely that the waters of the ocean would

continue at a higher level than formerly. Is this not the case in Polynesia? The waters of the Pacific are higher than those of the Atlantic and are rising very slowly. The view put forward, in short, is that earthquakes do not swallow lands, but the cause of earthquakes may drown them, and that the same cause has added and still adds to the bulk of the oceans and seas.

NOT ALL VOLCANIC MATERIAL EJECTED FROM VOLCANOES

107. A good deal has been said in the preceding pages as to the productivity of volcanoes. It is not necessary to say much more about the various lavas except to draw one or two conclusions. As a general rule volcanoes eject trachyte, a formation which indicates less complete fusion than in the basaltic lavas and consequently less power than would produce basalt. It is true that basaltic conglomerates have been ejected in very major eruptions, but it cannot be said to have been proved beyond a shadow of doubt that because enormous basaltic sheets have been discovered in the vicinity of volcanoes they were necessarily ejected by the vent. A good deal has been advanced to the contrary. In fact, the output of volcanoes seems to be systematised by a lower state of fusion than would account for the presence of great masses of highly-fused rocks, and by an inability to expel the lava very far, as it congeals at once. We are entitled therefore in the case of great mountain masses,

such as the Alps, or Cordilleras, or Auvergnes, or Pyrenees, or any other range, to attribute the presence of fused rocks not to series of volcanoes, but to enormous deposits of meteoric bodies in a highly incandescent state upon which the volcanoes are merely incidental as the foci of discharge.

FORMATION OF COAL SEAMS

108. Nor can it be argued satisfactorily from other evidences that volcanoes produce either the minerals, acids, salines, naphtha, or oils. These appear where volcanoes are not, as in the Charlestown earthquake, and while these substances are found as the result of an eruption, they are not discoverable in periods of quiescence other than as exceptions or as gases as the result of an eruption. Another instance of the limitations of volcanoes is shown by a comparison of a coalfield and the carbonisation effected by an eruption. When trees are enveloped in lava the upper parts alone blaze and are reduced to ashes; the trunk is merely carbonised superficially, and if subsequently removed may leave its impression as a hollow cylindrical tube within the rock, thus showing that the lava cannot exert enough heat or pressure to carbonise it effectually. The trunk of a tree found at Mt. Dore showed one end reduced to perfect jet and the other not carbonised at all. In Hungary wood has been sometimes silicified and changed into opal. If volcanoes are able to

demonstrate the method yet they cannot envelop and carbonise vast forests. Coal, it will be admitted, is the result of very considerable and probably prolonged heat added to extraordinary pressure upon the trees of a primeval forest. When the overlying rocks of a coalfield are examined, such as the igneous rocks over the Welsh, Northumberland, Derbyshire, or Somerset coalfields, the procedure can be imagined if the principle of a meteoric deposit be conceded. What were formerly majestic forests were suddenly enveloped in enormous sheets of burning sandstone, or mineral rocks, or boiling clay, or boulder clay, which diffused an enormous heat to a very considerable depth and treated the forest trees to a very high carbonising process. Extraordinary pressure was exerted over the area as the fall expanded ; gases, oils, steam, acids, and other excreta were injected or leaked through the crevices of the congealing overhead and superincumbent masses. With all this the trees would be reduced to a pulp and then steadily carbonised until we find them, ages later, as veins of coal of various qualities, and, where the carbonising process has not been so complete, with an excess of oil shale. The coal in parts of Somerset and in East Dorset, both volcanic regions, contains a great deal of sulphur, and at present, owing to the difficulty of extracting, the sulphur is not much mined.

108A. The most famous coalfield in the world is that of South Wales, and it bears full evidence to-day of its origin. At one time this region of coal was occupied to a large extent by a big lake or lagoon in a district of Old Red Sandstone, upon which at a subsequent date were thrown beds of mountain limestone, the foundations whereon grew the forests later carbonised. The greatest depths of the coal measures are assessed at 6,650 feet in thickness. Actually what must have happened to form the coal was a catastrophe accompanied by prodigious earthquakes, throwing many of the forest trees into chasms, while simultaneously a vast downpour of intensely heated rocks and sandstone buried the forests, thus forming lofty hills above them, in which gigantic carbonising kiln the coal was made. Geologists speak of this carboniferous epoch as one in which, owing to a shrinkage of the earth's crust, the coal measures were *upheaved* to their present elevation, but apart from the difficulty of realising how a shrinkage could lead to an elevation, instead of the reverse, how could the products of earth-grown trees be elevated ? They could be buried beneath superincumbent masses, as they have been, but geologists find it extremely difficult to explain why the coal deposits are found sometimes 6,000 feet down, and at the same time why great sandstone mountains have been raised above them.

108B. This region of South Wales from the Severn to Pembroke, like Somerset and Devon, bears the marks of a period when it presented the aspect of a vast accumulation of flames, and this is doubtless the reason that it is traditionally the Celtic Hades. Along the north of this area the Great Skirrid (1,596 feet) marks the orifice of a dead volcanic cone; likewise the Blorenge, by the Usk (1,832 feet), and also the Sugarloaf, with its narrow ridge and conical head, indicate their origin. In the neighbourhood of the Carmarthen Van (2,632 feet) are at least five additional volcanoes, in several instances superimposed on extinct craters. The Vale of Neath shows the remains of eleven or twelve, and Pembroke in a great cluster, headed by Preceley Top (1,769 feet), at least sixteen cones pointing to a direction from north-east to south-west. Here and in the Carmarthen Mountains, where the River Twrch (Torch) flows, like the flaming Phlegethon in Homer's Hades, was the area where the burning mountains falling upon the land were most fierce, and from the same region comes the best Welsh steam anthracite coal.

VOLCANOES THE PASSIVE AGENT

109. The volcano, therefore, while performing so vital a part in the history of the world and the creation of organic life, acts as the agent rather than as the principal, as the passive factor, and not the active element. Volcanoes attract the meteor, and thus their function is that of Mother Earth, and by this combination our planet is built up of the residue of former worlds, which in the course of ages passed through the periods of birth, adolescence and old age, becoming, it would seem,

more and more remote from their sun, the centre of their system, until at last, by the Divine will, they fell, like Lucifer, disintegrated masses, as worlds in flames, destined to feed a sun and to augment other planets. Thus the mighty process continues of creation and destruction, of destruction and creation, until after a period of vast catastrophes the survivors witness a new heaven and a new earth, as spoken of in Revelation.

CHAPTER VIII

COMETS AND THEIR GASES

SOLIDITY OF COMETARY NUCLEI

METEORS are the residue of comets. Obeying some law of the universe, a comet, when it disintegrates into smaller particles, joins one or other of the various meteor streams which cross the earth's path annually, such as the Leonids in March, the Aquarids in May, the Perseids in July and also in August to September, and the Gemenids in October to November. There are forty recognised separate meteor streams in all, and these frequently vary their radiant point to a slight extent.

111. The nature of a comet may be understood from the evidence of its tail and gases, as identified by the spectroscope. It is composed apparently of a solid body or aggregation of solid or liquefied bodies forming the nucleus, and attached to it is a gaseous tail, more or less extended and filmy, which as it spreads out over an enormous area in space becomes more and more diaphanous and filmy. Professor Howe, F.R.A.S.,* describes a comet as a loose aggregation of small bodies like so much grape shot and with particles like sand.

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* "Study of the Sky."

Their solidity may, however, be judged by the fact that Herschel reported of the 1807 comet that stars could be seen through the tail, although they shed some of their lustre, and one near the head was only faintly visible by glimpses. In 1890 an eleventh magnitude star disappeared during the passage of Denning's comet. Newton thought that comets were fixed, solid and compact bodies, Halley believed a contact with the earth by no means impossible, and Cheyne concluded that comets have brought and may still bring about the great catastrophe of our earth. The size of comets varies, no doubt, although it is impossible to gauge their distance. Lexell's comet of 1770 was said to have had a nucleus five times the size of the moon. Mr. Edmund Neison, F.R.A.S.,* defines comets as a system of highly rarefied gases surrounding a mass of meteors, mostly small. He thinks these meteors are mostly the size of peas, but admits that meteors have fallen nearly a ton in weight. Indeed, very grudging admissions of the solid capacity of meteors are the best that can be apparently extracted from modern astronomers.

112. Sir Robert Ball, F.R.A.S., in his "Story of the Heavens," mentions that a fall of meteorites in 1902 at L'Aigle, Normandy, caused these stones to be removed from the province of geology to that of astronomy! He admits that meteorites are "evidently pieces broken from some larger object." The case of the Chaco meteorite greatly puzzled

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* "Astronomy."

him. This meteorite, weighing about thirty pounds, was of varied material agglomerated into a single mass, " in the manner of certain well-known volcanic rocks," and the Chaco meteorite, he believed, must have come " from some body of considerable, if not of vast, dimensions." The well-known volcanic rocks referred to by Ball are those given sometimes the descriptive title of " bombs." When found they are always indicative of a violent eruption, and are generally pear or almond-shaped. The lava of a " bomb " clusters around the nucleus of some fragmentary piece of rock, has been more highly fused, and being more solid than the lighter cellular felspathose lavas, resists time and weather longer. The Chaco meteorite surprised Ball (although it should not have done so), because its presence proved that some other agency than a volcano was responsible. Another meteorite which gave the astronomers something to think over was the Orgeuil meteorite, which fell at the place of that name in 1864. Its diameter was some hundreds of yards, and fragments were discovered over a track fifteen miles in length.

112A. The astonishing ignorance or indifference to the obvious potentialities of these minor bodies is exemplified in another meteorite which fell near the Franco-Portuguese frontier at the end of August or beginning of September last. M. Camille Flammarion, the distinguished French astronomer, interviewed two months later (*Daily Express*, November 6th, 1924), described this meteorite.

It bored a deep hole in the ground, and " burned like lava when found." The meteorite or " uranolith," as M. Flammarion called it, weighed about two hundredweight, was calculated to have struck the earth at a speed of nearly thirty-six miles per second (2,160 miles per hour and over 50,000 miles per diem) and consisted largely of cobalt with other substances. But only an astronomer from whom all wonders are accepted unquestionably could venture to claim that this meteorite was the " remnant of an interplanetary disturbance that probably occurred two million years ago." There is not a vestige of evidence to support in point of time so astounding an assertion, but there is a great deal in refutation of it, as will be seen. None the less, if some interplanetary disturbance broke up planets and sent disjointed members to wander through space, whether two million years ago or recently, is it not equally possible for a similar event to occur to-day, and are not comets evidence that in fact there is a constant menace to our planet and to others by the fall of such bodies ?

COMPOSITION OF COMETARY GASES

113. The tails of comets, as revealed by the spectroscope, include all gases known to chemistry. They reveal the spectra of hydrogen, nitrogen, hydrocarbon, sodium, iron vapour, magnesium, calcium, the deadly cyanogen and other gases. Frequently the tails or gases are turned in the direction of the earth, and after contact with the

sun sometimes the tails drift away. Newton believed the gaseous vapours from comets were attracted towards planets, and intermingled with the earth's atmosphere. He thought their condensed vapours replenished the earth and seas. He ascribed occult influences to these and suggested that the spirit, the " finest and most subtle part of our air," came chiefly from comets. Cassini believed that they induced changes in air and climate. Diseases have been attributed to them. Daniel Webster, the lexicographist, considered that influenza was caused by the gases of a comet projected into our atmosphere. The Black Death of 1333, which depopulated enormous areas in Europe, and was thought to have begun in Italy, was accompanied by an earthquake and volcanic eruption and a peculiar haze in the atmosphere. The Plague of London of 1665 was simultaneous with a great comet and a haze mentioned by Defoe, and even recently the sleeping sickness which reached the proportions of an epidemic in Japan coincided with the earthquake of September, 1923. The belief of the ancients that a comet brought pestilence and death was universal, as may be seen in the account of King David's terror at the vision of the Angel of the Lord, with a bent arm holding a sword, witnessed by him at the threshing-floor of Ornan. As a result of this comet a pestilence broke out, and thousands died.

114. While touching upon this aspect of come-

tary gases or vapours, perhaps I may remind the reader that all animate objects, animal or vegetable, are responsive to gases, beneficent or malignant. In this age, when we can manufacture various poison gases invisible to the eye and odourless, it is evident that gases of a similar character, like cyanogen, projected into our atmosphere can be the original causes of those sudden and disastrous epidemics which so frequently destroy men or beasts like flies. These disorders are invariably a form of blood-poisoning which reacts on certain temperaments more than on others. The bubonic plague of 1896–97 in India killed hundreds of thousands of natives, but the Europeans, who took no precautions, were totally unaffected, although in Bombay they moved freely in the native quarters. I believe only two Europeans died of it, and the reason assigned for this surprising immunity was that the Europeans were more hygienic, but it was not a satisfactory reason to explain that in a city of over 800,000 people, where natives and Europeans lived in close contact, the addiction to a daily bath of the latter accounted for their immunity. The origin was attributed to rats because rats were affected in the same way, but its probable explanation is quite another thing. Man is affected chemically by certain combinations. The Oriental blood differs in subtle respects from the European, and what may destroy the one does not necessarily affect the other. In a recent work Mr. J. B. S. Haldane, a well-known biochemist, alludes to the fact that the American Army authorities have found that no less than 80 per cent. of the negro troops are immune from mustard gas vapour.* I think it will be discovered in due course that all contagious epidemics, from plague and influenza down to foot-and-mouth disease and swine fever among beasts, are atmospheric in origin, and that different types or creations are either prone to or immune from them according to the chemical reactions they may lack or possess.

115. When such a principle is accepted we may realise how it may operate upon a considerably wider scale than is afforded by diseases alone. If certain chemical formulæ in the shape of germs can influence the blood, who will deny the possibility that other forms may affect the mind? Man, the highest creation, is himself a modification of cosmic elements, a composite of cosmic forces seen and unseen. His intelligence consists of a highly sensitive psychological series of chords, which must respond to certain attractive forces, producing instinctive effects, such as joy or anger, love or hate, pity or cruelty, gaiety or gloom. It is a phenomenon to be witnessed commonly in regard to thunder in the air, which reacts on some people to such a degree that they are prostrated with violent headaches. It was believed by the ancients and based on events that comets were the original causes of general unrest, civil wars, the

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* "Callinicus: A Defence of Chemical Warfare," by J. B. S. Haldane.

overthrow of dynasties, and in the Scriptures (particularly in the apocryphal works of Esdras and the Book of Enoch) whenever a great natural catastrophe was expected at a certain period it was believed to be heralded in advance by wars, revolution, a general hatred, distrust, selfishness and lack of morality. Is this not in an occult way similar to the principle of the meteoric gases which precede any violent volcanic eruption ? Is this the medium whereby the Almighty influences human mentality ? The learned ancients evidently held such a view and described these mystic cometary gases as Shekinâh, the Veil, and the most sacred attribute of the Godhead (120).

EFFECT OF SOLAR RADIATION UPON COMETARY GASES

116. The visible tail of a comet as the body approaches closer towards the sun betrays strange movements which give it the appearance often as of some vast fabulous monster, such as a dragon or a fiery serpent, lashing its tail in agony as it plunges blindly forward along its allotted path. The effects of the solar rays operating upon this wanderer through space are seen in constant changes in its size and shape. It twists and contorts itself like a great writhing serpent, arches its back, throws its tail above its head and curves itself into an infinity of forms. These movements are due to the predominating gases, which in consequence of solar radiation are attracted or repelled

according to their nature. Hydrogen stands out in a straight line away from the sun; hydrocarbons curve and assume spiral forms; iron vapour causes a pronounced curve near the nucleus, as though a dragon were arching its throat. In some comets the tails are limited, but a nebula or cloud surrounds the nucleus; sometimes it adopts a fan-like form, like the tail of a hawk, whence the origin, perhaps, of that wonderful winged globe device used by the Egyptians and others as the symbol of the comet, an orb or globe with wings, a fan-tail, and serpents' heads crowning the orb.

117. Chalmers * says that the comets without tails outnumber those with them, which is tantamount to saying that more comets under observation are approaching us than are passing us horizontally. If a comet be heading straight towards the earth its tail would not show obviously, and it would present a luminous circular surface towards us, which causes astronomers often to proclaim such bodies as minor planets, although they soon disappear as they intersect the earth's orbit and pass on. If it passes horizontally the movements of the tail can be watched from day to day, and these vary according to the preponderating gases affected by solar radiation with the additional action of electricity. Moorhouse's comet of 1908, for example, exhibited pronounced ultraviolet hues, and explosions in the tail displayed the

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* Geo. F. Chalmers, F.R.A.S.: "The Story of the Comets."

presence in quantities of cyanogen. Bright jets or streams of light are projected from the nucleus which by their action determine the character of the gases. Sometimes the jets take the form of rams' horns, due to iron vapour, at others resembling goats' horns, streaming away in a curve, indicating hydrocarbon; very often the intense magnetic attraction of the sun induces the nucleus to throw out an envelope, as it were, which precedes it and assumes an umbrella-like form, of semicircular appearance, not unlike that very ancient and little-understood sacred device, the *tau*.

ANCIENT MYTHOLOGY AND COMETS

118. As the religious beliefs of the ancients have a very direct bearing on this investigation, it is not out of place to draw attention here to the initial reasons for their often strange forms of symbolism. The Egyptians represented their great god Ammon or Amen-Ra as seated in the vault of heaven, with the head and horns of a ram, holding a *tau* in his hand, and called him " The hidden One." Dionysus (from Διος, god, and Νύσος, serpent, the serpent god) was also depicted as a goat, with horns, surrounded by his horned and cloven-hoofed Sileni and Satyrs, or as a man with goat's horns and cloven hoof. There is the ancient myth of a great war in heaven between Cronus (Saturn) and Ammon (Jupiter), in which Dionysus, the son of Cronus, defeated Ammon. It may be one of those sacerdotal myths of double

meaning, but at least it appears to preserve the memory of an occasion when a comet struck our earth. The serpentine lines and curves of many comets are also responsible for that further and quite inexplicable symbol of the serpent which, until its meaning is recognised as relating to a comet, appears visionary, fantastic, and strange. Yet long ago the Phœnicians, as the vestiges of their religion passed down by Sanchoniathon show, recognised the comet as the hand of God and as the visible representation whereby He manifested Himself, and so they used this device. Sanchoniathon plainly gives the reason for it in the following passage, the italics being mine :

> Taautus * first attributed something of the divine nature to the serpent and the serpent tribe, in which he was followed by the Phœnicians and Egyptians. For this animal was esteemed by him to be the most inspired of all the reptiles *and of a fiery nature*, inasmuch as *it exhibits an incredible celerity*, *moving by its spirit*, without hands or feet or any of those external members by which other animals effect their motion ; *and in its progress it assumes a variety of forms*, *moving in a spiral course and darting forwards with whatever degree of swiftness it pleases*.†

118A. Such a passage plainly conveys the belief that the serpent was chosen because of its supposed resemblances to a comet, such as a " fiery nature," its " celerity," its " variety of forms," its " spiral course," and its " darting forwards." Indeed, it might justly be maintained that the serpent, with its often strange colouring, the metallic and deadly fascination of its eyes, its forked tongue and poison glands, its periods of rapid activity or equal sluggishness, comparable with a comet before and after attaining perihelion, is a true terrestrial manifestation in a small way of the serpent of the heavens. Who of understanding can question the identification when we discover in Revelation the description of how a great red dragon appeared in the heavens, with seven heads and ten horns and seven crowns (or coronas) upon his heads ? This dragon fought in heaven, and, " called the Devil and Satan," was cast out and fell on the earth, bringing with him, as it seemed, a third of the stars of heaven, and he cast out of his mouth water as a flood.* What is this but a veiled description of a gigantic cometary or meteor impact ? It is the secret of all religion, the fundamental basis being astronomy, in which the comet for various reasons fulfils the *rôle* of the Evil One.

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* Taautus was the Hermes of the Greeks, Thoth of the Egyptians, Teut or Teutates of the Gaels, from whence seem to be derived the words " teach " and " taught," the reference being, of course, to divine knowledge.

† Eusebius : Hist. Eccles.

118B. It is unquestionably the explanation of the murder of Osiris by his wicked brother Typhon, or Set, or Apap, an astronomical myth with a terrestrial application. Osiris, symbolical of the great civilisation of Egypt, which worshipped the god Amen-Ra, conceived perhaps as dwelling in the great star Sirius, was destroyed—that is to say, the Egyptian civilisation over which Osiris ruled was destroyed—by Typhon. This evil deity was represented as a terrible dragon, red in colour, with a hundred serpents' heads, various voices, and having destructive winds. His eyes darted fire, his voices were of thunder, and he contended with Zeus for the throne of the universe. In this war he sent forth streams of flame, but was vanquished after a gigantic battle, hurled to earth by lightning and was buried in Tartarus. Massey says: "There is a saying that the devil is known by his long tail, and the long tail of Satan may be seen as an appendage of Apap" (Set).*

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* Rev. xii.

In Egypt the memory of Typhon was odious and terrible, but the true facts were only taught certain initiates. Diodorus Siculus, carrying the legend of this event a little further, says that Typhon cut Osiris into twenty-six pieces, some of whose parts Isis found on the shores of Phœnicia and buried, suggestive thereby of a catastrophe of magnitude on the earth.

EARLY IMAGERY OF COMETS' APPEARANCE

119. Comets under the spectroscope are vari-coloured, sometimes white, yellowish, red, ruddy, pink, bluish-green and violet. Seneca, writing of the comet of 146 B.C., which appeared after the death of Demetrius, King of Syria, said it was little inferior to the sun in size, being a circle of red fire, sparkling with a light so bright as to surmount the obscurity of night. These colours explain much of the imagery of the winged globes which

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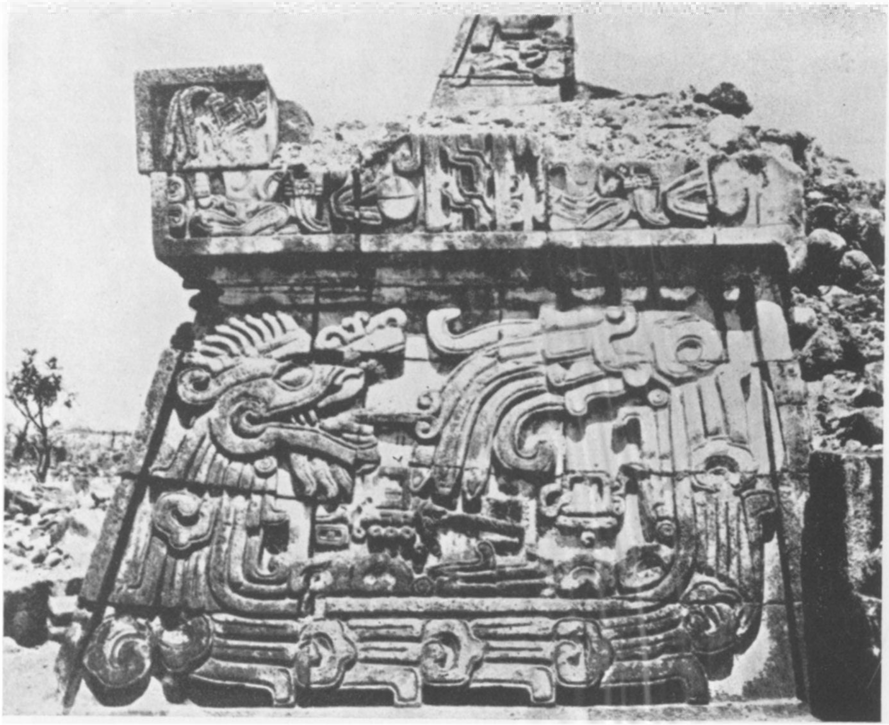
* Gerald Massey: "Ancient Egypt," vol. i., p. 287.



THE SERPENT SYMBOL SCULPTURED ON THE FAÇADE OF AN ANCIENT TEMPLE BUILT OF VOLCANIC STONE, AT XOCHICALCO, MEXICO.

[*To face p.* 150.

the Egyptians painted on the pylons of their temples in beautiful colourings. It was so, too, in Central America, where the Aztecs, Mayas, and Quiches represented the serpent in ornate colourings. The god Quetzalcoatl or Cuculkan (both of similar meaning) was conceived as a vast serpent adorned with feathers of blue, red, blue-green and yellow, and usually is found carved as a serpent with a corona and sometimes with a human head in his wide-open fangs, perhaps a reference to creation. He roared with a voice that could be heard a hundred miles away, and in the Popol-Vuh he is one of a trinity who create and destroy. Cuculkan, we are told, sat upon the waters before any mountains or life existed, and communed with "Hurakan" and "The Thunderbolt that Strikes." He was a serpent enveloped in feathers of green and blue. Nearer to ourselves we find in Avebury, Stonehenge, and Mt. Cruachan, in Argyllshire, three ancient circular temples, the first and last being serpentine in design. All have been proved to be astronomical in intention.

120. Comets, however, assume other forms than the two classic symbols of the winged globe and the heavenly serpent. Hevelius gives sketches of Pliny's comets which include such figures as disks, upright cones, a horse's mane, torch-shaped, sword-shaped, spear-shaped, bearded and "horror-producing." The various gases sometimes combine to give a comet the appearance of a human head with rough, unkempt hair and beard, whence

must have arisen the imagery of the satyrs, the boon companions of Dionysus, with their bristling hair and beards. Homer speaks of the " flaming hair " of a comet which shakes down disease, pestilence and war, and Juvenal, of the blazing star which menaced the Parthian King, as having " bloody hairs, all over rough and shaggy like a bushy head of hair." In 1528 the French were terrified of a comet described by a monk, Ambrose Paré : " This comet," he says, " was so horrible, so frightful, and it produced such great terror in the vulgar that some died of fear and others fell sick. It appeared to be of excessive length, and was of the colour of blood. At the summit was seen the figure of a bent arm, holding in his hand a great sword, as if about to strike. At the end of the point were three stars. On both sides of the rays of this comet were seen a great number of axes, knives, blood-coloured swords, among which were a great number of hideous human faces, with beards of bristling hair." Halley's comet of 1835 had horns like a bull, another symbol of Osiris as of Poseidon. Swift's comet of 1892 had a tail which developed into the appearance of an open fan. Brooks' comet of 1893 looked like a burning torch, and Encke's comet of 1872 gave the appearance of wheels within wheels. To summarise the appearance of a comet generally, it may be said to consist of a hazy mass, more compact and brilliant than the surrounding nebulosity, and this is the seat of the greatest activity. It throws out jets of vaporous matter towards the sun, while other jets are driven back towards the tail, and experiments with Geissler tubes prove these gases to be affected very considerably by electric discharges. The gases compose the envelope, or veil, and the tail whose possible effects have been mentioned. The veneration and fear of the ancients in these matters, and their influence upon all authoritative teaching, may be summed up from a passage of the Jewish Sohar, the greatest of the Kabals, on whose doctrines the Nicene Creed is said to be based—a passage hitherto quite incomprehensible, but at once understood when the reference is known. It says :

> Out of the subtle fire on one side of the White Head (of the Ancient of Days) and of the subtle air on the other emanates Shekinah, his Veil, the most occult attribute of the Ancient of Days. The Ancienter is the Concealed of the Concealed. The Cranium of the White Head has no beginning but its end has a shining reflection and a baldness.*

COMETS FEED THE SUN

121. The two great outer planets, Jupiter and Saturn, are alleged to attract comets into the Solar System. Howe states, in regard to Jupiter, that its attraction sometimes increases a comet's velocity, and its orbit becomes a parabola, or if it diminish it, an ellipse, and the comet becomes an attaché of the Sun. Many comets, mainly small, he states, come from the direction of Jupiter, and that planet is said to have " captured " them, whence they are labelled as members of the Jupiter family.† The

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* " Idra Rabbi," iii., 36, 171, 541–542.

† " Story of the Sky," p. 274.

same principle is said to apply to Saturn, accredited by the ancients as the main origin of comets, but Hale contends that Jupiter attracts the greater number. We cannot affirm if we cannot actually dispute this contention of planetary attraction, which, if it operate, should apply also to Uranus and Neptune beyond, for, after all, we do not know what magnetic attractions these great outer planets may command, and the law of nature seems to be based upon the law of attraction. As a candle draws a moth, as a woman attracts a man, as a volcano a meteor, so a planet may draw a comet, but there is a greater attractive force than any planet, namely, the Sun. Everything in our system is subsidiary to our great luminary, and in the first place, worlds in disintegration go to feed the Sun. Once comets are drawn into the Solar System they direct their path straight towards the Sun. To follow this through and to understand how a comet approaches and leaves the Sun, its after mission, and the relationship between comets and meteor streams, it is essential to examine the alleged "orbits" of cometary bodies.

CHAPTER IX

THE MISSION OF A COMET

COMETS AND THEIR PRESUMED ORBITS

COMETS are presumed to possess definite orbits which are calculated from the direction of their apparent motion. This theory, sustained by Halley, in relation to the comet bearing his name, is proving to be illusory, for some comets do not return at all, like Biela's comet, others arrive erratically either early or late, and others, whose orbits are estimated to require some phenomenal period of time, even as much as 100,000 years, may return in quite a short time. As to the latter class, there is a conjectural belief that the comets of 1880 [α] and 1887 were one and the same, as also the comets of 1882, 1889, and perhaps Brooks' comet of 1893.

123. When the career of a comet before and after attaining perihelion be taken into consideration it can be seen that no orbit is possible. In its approach towards the Sun's corona the nucleus is subjected to a powerful tidal strain and exposed to tremendous electrical energy which produces a considerable disintegrating effect. Before this solar contact has occurred and subsequent to it, the continued redirection of the nucleus to gases,

whereby the solid particles are fused and driven into the tail, must affect the weight and consequently any gravity which it might appear to possess. But if a body has no gravity, since at every moment it is wasting its own substance, it is evident that it cannot possess an orbit. Howe remarks that a periodic comet, moving in an ellipse, " loses substance " at each perihelion passage and " must be wasted away in time." It is an obvious truth, but this author understates the problem. It cannot move in any sustained elliptical orbit, or in any consistent orbit, although it may appear to do so, for the reason stated, that there can be no geometrical figure to represent a body whose weight (and consequently gravity) is rapidly decreasing at each instant.

124. Comets appear to possess orbits because they approach the Sun in one of three curves, as (*a*) an ellipse, (*b*) a parabola, or (*c*) an hyperbola. An ellipse is a closed curve, an oblong ; a parabola, which most comets are deemed to follow, is a wider ellipse but unclosed at one end, in other words, the half of a wide oval ; an hyperbola, more rare, is a slight curve which gives no indication of any orbit. In regard to these curves, forming in various degrees an alleged orbit, it needs to be said that if the Sun were stationary a comet, drawn towards it, would follow a straight line, but as both are moving it comes up along a parabolic line and whisks off momentarily along the same curve, induced by its momentum, until the pull of gravity checks it and

brings it round. If, therefore, a comet is performing an apparent parabola it must be reduced to an ellipse, and should it once again survive the strain of a perihelion passage, it must shorten that ellipse in consonance with the law of gravity in proportion to its weight, until at length it is irrevocably consumed. Such records as exist do not indicate anything but a short period for any comet after a perihelion contact.

125. If a comet could possibly sustain an orbit extending to hundreds to say nothing of thousands of years, the very rapid motion of these bodies would cause them to traverse other solar systems than ours, and it remains for those who advance so grotesque a theory to explain why, when beyond the attractive forces of our system, they should return. A well-known geometrician, Mr. C. L. Poor, has said that a parabolic orbit is a geometrical impossibility. He points out that a cometary body could not pursue a parabola for an instant, because, attracted by Jupiter or some other planet, its speed must be increased or decreased, which is impossible as a parabolic body cannot vary its rate of movement or it ceases to be a parabola. Yet to explain this so-called parabolic orbit theorists have conjured up a situation in which a comet as it passes beyond the attraction of the Sun becomes moribund, until Jupiter or some other body takes pity upon it.

126. As a cometary body by reason of its sustained and continued loss of weight cannot main-

tain a parabolic orbit, neither also can it continue along a hyperbolic course, for in either case the Sun's attraction must react upon it at a certain distance, taking velocity and weight into consideration, check its momentum, and bring it into the order of a temporary ellipse. It will be said that the so-called periodic comets, such as Halley's, Encke's, and formerly Biela's, prove that comets can, and do, possess orbits more or less regular and consistent, but such a contention cannot be sustained. The fact that a comet of a certain family appears more or less regularly is no proof that it is the same individual body, and the explanation of this is that comets are projected into the solar system in certain cycles, as also that they having been once projected into it, circumscribe temporary orbits of short periods (134A).

127. There is also the general consideration of these strange orbits of both periodic and long-distance comets to be examined. The three types of orbit defined by astronomers, namely, the ellipse, parabola and hyperbola are, on the face of it, entirely opposed to the laws of gravity. Satellites of the Sun, like our earth, maintain an equilibrium based on gravity at a certain distance from their great luminary, the Sun being the axis of an enormous wheel round which all the various planets, major and minor, revolve, in obedience to this same law of gravity. The comet, however, even of the short periodic type, approaches the Sun not only along an extended ellipse, but the Sun forms

the apex and not the axis of this ellipse. Should the approach of a comet be in the form of a parabola, it is even more pronouncedly the apex, the head stone, it might almost be said, of a pyramid. The case of the comet of 1882, which swung round 180 degrees of its ellipse within three hours, demonstrates quite plainly that such an orbit is one which cannot be pursued with any consistency, as it utterly defies the laws of gravity. Any elongated ellipse with the Sun at or near the apex is an impossible hypothesis to any continuity, and hence no comet can be other than transitory.

TANDEM COMETS AND THE LESSON OF PHÆTON

128. The 1880 [α] comet was of remarkable brightness and size, passed very close to the solar envelope at perihelion, and became correspondingly faint after. Like the 1882 comet, it divided into two and became a tandem or twin comet. It should be remarked that the comets of 1668, 1843, 1880, 1882 and 1887 all followed along the same track, coming from the direction of Canis Major (Sirius), and all of them appear to have become twin or tandem comets. This peculiarity recalls the myth of Phæton, to which Plato refers in connection with the destruction of Atlantis, as the "declination of heavenly bodies," causing a vast conflagration and flood on the earth, and as recurring at long intervals of time. The story of Phæton is undoubtedly the account of a very remarkable celestial event, which left behind it

certain terrestrial effects. He drove the steeds of his father's chariot (*i.e.*, two wheels, or a tandem) too near the earth, and almost set it on fire. Zeus, espying the danger to creation, killed him with a flash of lightning and cast him into the River Eridanus. Other legends associate the fate of Phæton with the destruction of Atlas and his daughters the Pleiades or Atlantides, whose tears, as they wept by the River Eridanus, turned into amber. I am not here concerned directly with the actual topography concerned in this legend, but it is curious to observe that it appears to point to an event in the region of the North Atlantic Ocean, within the region which for so long has been the danger zone of meteoric falls.

128A. The River Eridanus was mythologically the son of Oceanus, the Ocean (and there was but one Ocean) and Tethys, the Sea. It flowed through the country of the Gauls (or Galatai) and the Cimmerians were the Gallic or Gaelic race traditionally dwelling by this Eridanus, in a country, as Homer sang, beyond Ocean stream and unblest by the Sun. Amber, tin, and the Cimmerians are all alluded to by Herodotus as more or less fabulous, although that historian admitted that tin and amber came from the northern parts of the world. Amber, which in this poetic myth of Phæton was the outcome of his destruction by Zeus, is known to have been the product of tertiary coniferous trees, caused by the sudden petrifying of the sap in circumstances analogous to the making of coal, an event very sudden, as nearly 3,000 species of insects have been discovered imprisoned in the petrified sap. Amber, as Sir William Ridgeway and Andreas Mosso, amongst others, have pointed out, is a product almost entirely, if not exclusively, found in the region of the Baltic, the North Sea, and the British Isles.*

128B. Tatian, Clement, and Eusebius, all agreed that the Phæton event was identical with the Deucalion Flood, and with this Deucalion Flood Sirius, the Dog-star, was traditionally linked. The Helios, or Sun, whose steeds Phæton drove, was not, I suggest, our Sun, but the star Sirius, regarded by the Egyptians and Phœnicians as the central sun of the universe (145). It is at least noteworthy that this cycle of legends points to those very regions in the Atlantic indicated by the volcanic linear belt, particularly to the British Isles, famed in Roman days as the Celtic Underworld, the legendary scene of a world catastrophe, where, too, we discover both amber and tin. Be this as it may, the Phæton account does definitely propose that at some past date a comet, like that of 1880 [α], coming from the direction of Sirius, broke into a tandem comet after perihelion, flung itself or was flung upon the earth in the regions of the Atlantic, burnt up great areas, caused the Deucalion Flood, and left as one of its evidences, amber. There is reason to believe that the word "amber" was applied not only to the stone of that name, but to coal, which was evidently sought and used by the Greeks and Romans, for old coal-workings have been discovered in the British Isles opened up at a very early date.

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* Ridgeway: "Early Age of Greece"; Mosso: "Dawn of Mediterranean Civilisation."

COMETARY PHENOMENA APPROACHING PERIHELION

129. The 1882 comet was one of the most magnificent of late years. It was bright enough to be visible in bright daylight close to the Sun. On September 17th, 1882, it passed across the Sun, within 300,000 miles of the photosphere, and dashed directly through the corona. Within three hours it swung round 180 degrees of its orbit and continued onwards with speed unabated, but the nucleus was interrupted, for *within a month* it broke into two centres of condensation, with a tail estimated at 100,000,000 miles. Later, along its track six or more filmy *débris* were observed which suggests that its career was finished, yet, judging from the elongated ellipse it followed, astronomers calculate its return in the middle of the twenty-seventh century !* The spectrum of this comet revealed hydro-carbons, sodium and iron, while calcium and manganese were suspected of being present.

130. The progress of this comet, like others, showed the enormous toll imposed by the Sun as the body tore towards it. This process of change is one that fascinates and awes the observer. The

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* Howe, p. 283.

mass and nebulæ become more excited every day, as nebulous clouds are thrown off from the nucleus, which exhibits every evidence of extreme perturbation. Newton estimated the heat of the comet of 1680 to be nearly 2,000 times that of red-hot iron. In such circumstances every soluble is reduced to its primary and constituent parts, and the various minerals forming the nucleus are in a highly incandescent condition, any solids colliding and scraping against one another, grinding or flaking according to the class of mineral. Yet, even amid this awful chaos, there is a certain order, for the materia, governed by the weight of its units to molecules, falls into line—such as boulders, clay, gravel, chalk and sand—when follows the gaseous tail according to the specific gravity of its gases and spreads, perhaps, over an area of millions of miles. If geologists would study this aspect of astronomy they would, perhaps, revise their estimates of the origin of the sandstone and chalk hills in various parts. Chalk may be the disintegrated particles of mollusca, but they have been subjected to the ordeal of fire and sorted out in their former journey from some other world before they reached ours.

SOME FAMOUS COMETS

131. One of the most interesting cometary histories is that of Biela's comet, discovered by an Austrian, after whom it was named, in the eighteenth century. Its period was about every six and three-quarter years, but it was not always

observed. In 1832 its track was calculated to cross the path of the earth and, in spite of the calm unconcern of astronomers, great fear was felt in France and the United States of a collision, with the result that the churches were crowded. Thirteen years later another (so-called) visit was paid by Biela's, but after attaining perihelion it split into two parts, which drifted nearly 150,000 miles apart, tails shot out and the two nuclei burst into rival activity. It was conjectured that Biela's may have struck some solid body in space. There was an arc light as a bridge between the two parts. In 1852, Biela's was identified as a twin comet, but the distance between them had enormously increased. Since that year it has never been identified, but in 1866, in November, the period of Biela's return, the world beheld a most brilliant meteor shower, and in 1872, 1885 and 1892, corresponding with its former orbit, there were imposing displays of meteors in November. In 1892 another remarkable shower was witnessed in the United States. This same year coincided with two other comets, Swift's and Holmes', which many thought was Biela's. In America the public were terrified, and again flocked into the churches. Elgie * suggests that the November Andromedes meteors may be the remains of Biela's comet, and the Glamorgan "tornado" of November 1st, 1913, may have been a vestige of this body. It is to be remarked that the months of May and November, the one

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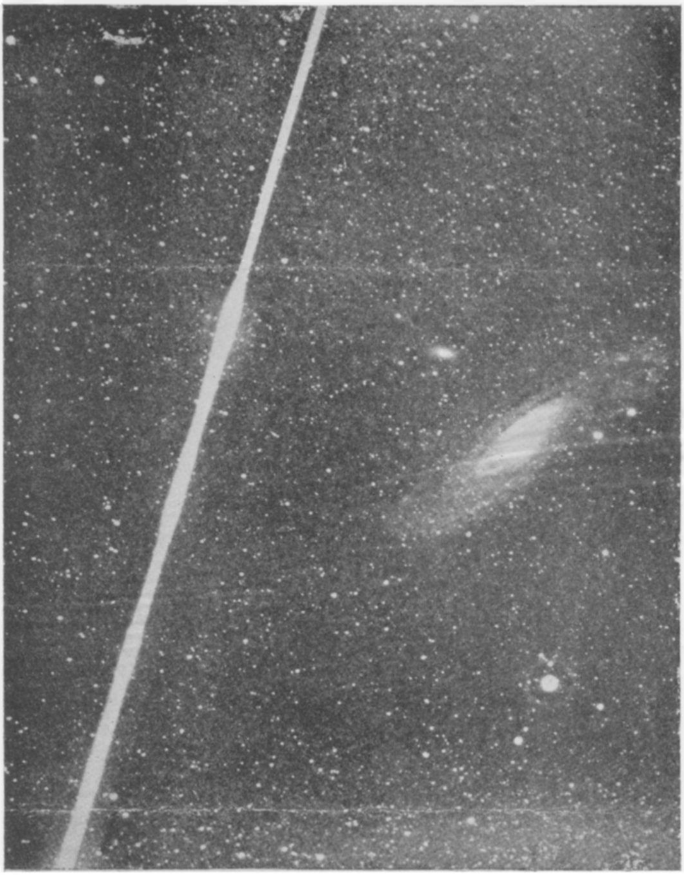
* Jos. H. Elgie, F.R.A.S.: "The Stars Night by Night."



THE METEOR OF SEPTEMBER 12TH, 1923, FALLING TANGENTIALLY. THIS PHOTOGRAPH ILLUSTRATES THE RAPID MOVEMENT OF A METEORIC BODY.

[*To face p.* 164.

related to Halley's comet, and the other to Biela's, were the days specially noted by the ancients as the dangerous periods. If Biela's had collided with the earth in 1832, it would stagger the imagination to foretell the effects, and yet it was quite a possible contingency.

132. Biela's comet is not the only lost one by any manner of means. Lexell's, 1770, with a nucleus said to have been five times the size of the moon, was supposed to have had a period of five and a half years, but it has never again been seen. Another missing member is Brorsen's comet of 1846, which has failed to appear at its allotted times. Tempel's comet of 1865–66 belongs to a class which seems to be related to the Leonids of every thirty-three and one-third years. Donati's comet of 1858 was the most splendid comet of the century. It had a head like a serpent, its body near the nucleus twisted and turned like a gigantic red serpent, and its tail, flashing like golden scales, spread over forty million miles. It has never returned. The comet of 1889 displayed some strange methods after perihelion. It had four attendant sprites, two faint, which soon died out, and two like the parent body. The latter two drifted apart, one faded, and the other returned with a swelled nucleus and no tail.

133. Holmes' comet of 1892 followed a path which brought it near the earth, and much apprehension was aroused. It was round and sharply defined, but after perihelion became exceedingly faint. It afterwards suddenly brightened and then

disappeared. The path of this comet, directed between Mars and Jupiter in the zone of minor planets, has caused many to wonder whether it did not appulse upon one of these, thus creating a new epoch in its existence. Brooks' comet of 1893 was also interesting. It had four attendants. On October 20th it had two tails, one symmetrical, but the next day the tail was shattered, bent, distorted and deflected. The nucleus broke into knots, and the appearance was that of a fiery torch. The general opinion was that it had struck some solid obstacle in space. Encke's comet is, of all cometary bodies, the most reliable. Its orbit is about three and one-third years, the smallest of all, but it falsifies calculations by generally arriving ahead of its time. The explanation put forward by astronomers is that Encke's is losing centrifugal force, is shortening its orbit, and is consequently being pulled nearer the Sun, into whose fiery embrace it must inevitably be absorbed. It should be noted in passing that the comets with the apparent shorter orbits are more consistent than the remainder, although themselves erratic.

Residue of Comets Join the Meteor Streams

134. The most famous comet is Halley's, and it has been lightly proposed as the comet of 43 B.C., which was believed to portend the assassination of Cæsar, as also that of 1066, when William the Conqueror overthrew Harold and the Saxons. It is given an orbit of seventy-six years, but, unless

all the laws of gravity are to be overthrown, it is physically impossible for a body in a state of disintegration, as it is shown comets are (123), to return century after century along an orbit which cannot possibly exist. It is impossible, on the face of it, that a comet could possess such an extended orbit in any circumstances. The outer and greater planets of enormous volume require the following periods to complete a circuit round the Sun: Neptune, 164.622 years; Uranus, 84.018; Saturn, 29.458; and Jupiter, 11.862; yet Halley's comet, burning violently away, required seventy-six years, over six times the period needed for Jupiter, and over two and a half times the period of enormous Saturn.

134A. To be a consistent satellite of the Sun on the same basis as the planetary system, Halley's comet would require to be seventy-six times the specific gravity of the earth, and over two and a half times that of Saturn, but, as mentioned, this in any case is an impossibility, because it is continuously exhausting its substance and consequently losing centrifugal force. As Halley's comet approaches the Sun along an extended ellipse, or even a parabola, with the Sun forming the apex of the ellipse, and is reducing its specific gravity every instant as it moves towards the Sun, or, after solar contact, as it recedes, any assumption that this comet could, after all this, disappear along a specified and consistent orbit is based upon an absolute defiance of all the laws of gravity. The last appearance of the cometary body alleged to be Halley's was in 1910. It had a long streaming tail, clear evidence of its rapid combustion. Astronomers believe that the Aquarids appearing in the first week of May contain the remains or parts of Halley's, and suggest that the brilliant meteors flashing through the heavens at that time are the fragments of its materia scattered along an extensive orbit. In such a case, although another comet was called Halley's in 1910, it cannot be the same previous body. It can only represent a system of cometary phenomena. The identification of comets—there are many every year—is a very loose process, and reflects but little credit upon the perspicacity of astronomers generally. Fortunately the Americans are turning their attention to the whole question, which is one of paramount importance.

135. Such an admission as mentioned leads to certain obvious conclusions. If Halley's comet has disappeared itself among the Aquarids of May, it can no longer be disporting in the heavens as the entity first historically recognised in 43 B.C. It can no longer be a periodic comet. It must have broken up to join one or other of the meteoric streams, as have Biela's and Tempel's, and this suggests that the meteor streams are recruited from the remains of former comets. Modern investigation, backward as it is in regard to meteorology, admits that the comet of 1862 [γ] joined the Perseids, Halley's the Aquarids, Tem-

pel's the Leonids, and Biela's the Andromedes. The whole question of these various meteor streams is wrapped in mystery, but it is known they follow enormous elliptic orbits with the Sun as the apex. The individual particles of a comet which join one or other of these streams are evidently gathered up and in due course are drawn into the vortex of the Sun. The interesting suggestion that Tempel's comet has joined the Leonids and that its remains are signalised by a particularly brilliant display every thirty-three and one-third years implies, if correct, that these meteor streams complete enormous extended ellipses, and are constantly augmented by the residue of comets. From these streams issue the stragglers which strike the earth so frequently. But the movements of the various meteor streams are as yet quite elusive; they are evidently erratic and uncertain; and, again, the probable solution of their variability will be found eventually to be related to gravity.

The Mission of a Comet

136. The study of Nature's laws teaches us that nothing is lost, nothing finally is wasted, yet, so far as our finite minds can discriminate, everything has its appointed ultimate conclusions. Leaving aside such transient features as nations and civilisations, our world, venerable and immortal as it might seem, is yet a satellite of the Sun, as that Sun is of other suns, until at length there arrives

that inner glory of all, around whom the host of heaven humbly and eternally revolves. In this vast and awe-inspiring system of the universe worlds come and go, play their parts and collapse as suns in time must do, as perhaps Bickerton's theory explains—in a collision of suns, like the great nucleus in Orion. Meantime, is it to be supposed that a dead sun or a dead planet falls through infinite space for ever and for ever? On the contrary, while we can only judge by our own solar system we can see that such is not the case. As a comet contains the spectra of all the gases known on earth, and as we trace a comet from a meteor and meteors are proved to contain the rocks and minerals we possess on the earth, so we are justified in believing, with the ancients, that a comet is a world belonging to another system, that it is in a state of rapid disintegration, and that every particle of it is used, in due course, nucleus and tail, for the replenishment of the Sun and the planets.

137. What, then, is its final mission once it enters our solar system and, presumably, any other? It is drawn directly towards the Sun, and as examination proves, it leaves a proportion, more or less, of its substance, attracted thereby into that majestic body. Sometimes it is more, sometimes less. Yet, whether more or less, the meteor streams in due course appear to gather the residue and to act as gigantic and continuous feeders to the Sun. I suggest the conclusions to be drawn from the

alleged orbits of Halley's, Biela's, Encke's, and other comets is that, first of all, within definite periods of time, by some act beyond human ken, a comet is attracted into our system, and that once within it, the final chapter in its history is to feed the Sun and the planets. Its first perihelion contact may be distant or close ; if the former it joins, say, the apparent motion of a Swift (1889 [ζ]) of 8.534 years, or a Faye of 7.566 years, or a D'Arrest of 6.691 years, a Tempel, 6.507, or a Finlay, 6.627, and so on through the gamut of apparent motions from eight and a half years or more down to three and one-third. It will reappear, after perihelion, as it vanishes from the observation of astronomers, until the law of gravity stops its decline, and brings it back with reawakened activity into the orbit of motion to which its then weight entitles it. It may be then given a new name, ascribed a short-time area, and proceed to a new phase. If, after a second contact with the Sun, it survives sufficiently to preserve its individuality, it may join the Encke category. Sooner or later, however, it must contribute what residue it has preserved to one or other of the meteor streams, which follow along a procession, as the ancients termed them, of the Holy Ones, and these appear steadily to nourish the Sun.

Explanation of Sunspots

138. A good deal of disagreement has occurred among astronomers as to the causation of sunspots.

It is at any rate fairly certain that a sunspot is an uprush of gases from a lower layer of the Sun's envelope, and is often, if not always, associated with a solar prominence, such as are measured to a distance of many thousands of miles from the surface. For some years past regular determinations have been made of the so-called radiation " constant," which indicates the intensity of the radiation received by the earth from the Sun, and it is discovered that the Sun's activity is greater when there are many spots than when there are few. This implies that the Sun's activity has been replenished by the cause of the sunspot or sunspots. These sunspots on occasions produce great magnetic storms, such as those in September, 1903, which prevented cable communication with South America. There is also one historical instance of a remarkable outburst on the Sun, on September 5th, 1859, which was actually seen by two observers, Carrington and Hodgson, at the moment of outbreak, and was accompanied almost instantly by a magnetic disturbance on earth. It is quite possible that it was caused by the impact of Donati's comet of 1858, which was so electrically powerful, had in the interim returned within a circumscribed orbit, and then had plunged into the great orb.

139. Sunspots, in fact, must be caused by exactly the same method as volcanoes are thrown into eruption, as evidenced by the moon with her vast meteor craters, but the big sunspots at least occur

on a colossal scale. When we witness the devastation which can be committed by a meteor of comparatively insignificant size on earth, knowing it to be only an infinitesimal portion of the original nucleus, it requires little imagination to divine what would be the effect of a vast cometary body when it penetrates the Sun's envelope and plunges into his internal fires. An appulsion by any such considerable body if and when it should strike the earth would probably be sufficient to throw it into violent combustion, and even, perhaps, occasion another comet flying through space, for if the affliction of the late Tertiary Age could add five days to the annual orbit of the earth, being only one seventy-third of its weight, prodigious as its effects were, what would result in the case of collision with a body of its own weight ? And thus, by this means, is the Sun replenished throughout the ages.

EFFECT OF GRAVITY ON A DISINTEGRATING BODY

140. The circumstances, therefore, relating to comets which appear within the Solar System have been passed in review. How they are attracted, whether by the outer planets, or whether by the Sun, the fact remains that they are projected into our system. They seem to follow certain periodic laws such as the Halley system of every seventy-six years, although the attempt to identify a class or family with one individual comet has led to much misconception. The shorter so-called periodic

comets, although each is but an individual in a group, also point to definite laws whereby they are introduced. Yet these laws are sufficiently elastic, inasmuch as sometimes a comet does not return at the period it is due, and sometimes more than one comet appears in company.

141. An examination of their orbits shows that no comet can possibly possess any orbit except an apparent and temporary one, because the body itself is losing weight at every instant and cannot thereby sustain any regular orbit. The fact that a comet approaching perihelion very considerably accelerates its pace, so that we have the astounding instance of a comet swinging round half the circumference of its orbit within three hours, is proof positive that to describe such action as an " orbit " is absurd, and that we witness in comets phenomena entirely removed from the ordinary action of stable celestial bodies. In like manner to their eccentricity in the form of orbit so is their speed, for it is commonly noted that a comet after its phenomenal rush to perihelion afterwards slows down, shows pronounced sluggishness and appears to become moribund. This must assuredly be due to the pull of gravity, with the result (though not always or scarcely ever observable because for a time the nucleus and tail show no signs of activity) that the body again begins a fresh sinuous movement towards the Sun. It is highly probable that the comet of 1887 was the return of the comet of 1880 [α]. When we have the comet of 1882 with

several filmy *débris*, that of 1889 with four attendants, and Brooks' comet of 1893 also with four attendants, which suddenly shot into activity like a fiery torch soon after perihelion, can we not in all likelihood perceive the process of one comet in all its various stages inexorably drawn into the magnetic attraction of solar radiation? The flight is checked by the action of gravity, and the comet fulfils its allotted task, after one, two, three or more shortened periods, the residue joining one or other of the meteor streams and being swept into the fiery embrace of our great luminary in due time.

SIZE AND SOLID COMPOSITION OF THESE BODIES

142. How great in substance comets may be is undetermined, but we should not dismiss as fantastic the enormous size attributed by Seneca to the 47 B.C. comet, or that of Lexell's of 1770. While the size is relative to distance, yet undoubtedly sunspots have been measured *thousands of miles in diameter*, and when we possess within our own solar system such immense bodies as Neptune or Saturn, and on the assumption that comets are planets in a state of disintegration, it is not astonishing that they should be sometimes of enormous size. It is apparent that such bodies are not attracted to the earth whatever may be assumed in regard to the great outer planets (121), because if such were the case the world's history, which we can read by its rocks and stones, would be very different, but it is certain that in due course

such a collision will be the appointed end of our planet. The normal procedure, however, is that a comet is directly attracted to the Sun and to the Sun alone, as we can trace this same magnetic attraction in a minor degree whereby a meteor if apparently it comes within certain range of the earth is attracted to the region of an active volcano.

143. The evidence before us entirely discounts the theories of certain astronomers that a comet is a loose aggregation of small bodies as Howe contends, or of small meteors about the size of peas as Neison thinks—both these views being the generality of opinion among astronomers—for we have an overwhelming amount of evidence to the effect that individual meteors may project rocks and stones of enormous volume and size, such as mentioned in the case of Jorullo, with its six volcanic cones, scoriæ and basalt (58, 58A). Besides such instances as have been cited of meteors leaving considerable deposits there are the cases of rock pinnacles, or *blocs perchés*, upon often inaccessible heights, as for example above the lake of Neuchâtel, Switzerland, where perched on a spur 1,000 feet up is a huge granite boulder, foreign to the locality, which weighs about 15,000 tons. In the face of such evident facts, when, too, Sir Robert Ball regarded the Chaco meteorite as a small particle broken off from a considerable or vast body, it is regrettable that men engaged in scientific research should be guilty of such loose, inaccurate and misleading generalities. Judging

from meteorites and meteors the nucleus of a comet is as solid as the core of the earth, and may be considerably bigger.

VARIABILITY OF THE METEOR STREAM

144. What is of more immediate importance to the world of human beings is the final career of a comet after perihelion. There, it seems, is where the danger lies. For such time as the nucleus preserves its comparative solidity it is undoubtedly subject to the laws of gravity and is drawn afresh to the Sun. But it appears likely that if a comet should disintegrate into several parts like that of the comet of 1882 it may be beyond the action of gravity when this occurs, and it is then, perhaps, by the operation of some other law, that these disintegrated particles, although of very considerable extent, are attracted into the meteor stream. It is very possible that by some such circumstances as outlined here have come about the various geological ages when very considerable deposits were flung on the earth. Whatever the actual *modus operandi*, at least certain specific factors enter into such appulsions which point to the general correctness of these inferences ; the direction of the fall of meteors on the earth being from the pole of the heavens implies that the falling bodies have come from the direction of the Sun and are moving away from it at the time of contact ; that periodically the radiant of meteoric streams appears to shift, and such periods may

bring the earth into closer proximity to meteoric collisions ; and that all such bodies contain the same minerals and gases as are discovered in connection with the procedure of volcanic eruptions or earthquakes or both.

COMETARY IMPACT PRESERVED IN MYTHS AND TRADITIONS

145. Before closing this chapter it is useful to revert once more to the ancient views on cometary impact as evidenced in the Phæton myth, and Osiris and Typhon or Set, and the red dragon or Satan of Revelation with seven heads, ten horns, and seven crowns. The Phæton myth, as was stated, was believed to be identical with the Flood of Deucalion, and the great star Sirius was thought in some way to be connected traditionally with it. It is most probable that the " Sun " which the Egyptians worshipped as the Seat of God was no other than Sirius, the brightest star in the sky, and the great temple to the god at On, or Heliopolis, or Ha-Ra, the " abode of the Sun," related not to the Sun but to Sirius, the " Scorcher," described by Virgil as the " blazing star," that " brought droughts and diseases," and saddened the sky with his " inauspicious light." Sirius was of vast importance to the Egyptians, as by him they fixed their calender, because once in every 164½ years (in the cycle of four quadratures, making 658 years) he rises as the Day Star in the east a few minutes before the Sun, and is alone visible. The

Phæton myth suggests the ancients' belief that the destroying comet, flung with lightning into Tartarus or the River Eridanus, came from the direction of Sirius, was a twin comet, struck (as amber indicates) the northern parts of Europe, and devastated a huge area. The myth of Deucalion's Flood informs us further that Prometheus went into eruption as a preliminary warning and afterwards was driven into the earth. The mysteries of Osiris and Typhon indicate very clearly the destruction wrought. Finally, the Old Devil, the comet with six satellites, five being horned, shows us that it eventually broke up into seven parts. Thus we have the links in a chain of some meteoric event many thousands of years ago. It is identical, doubtlessly, with the battle of Marduk (or Heracles) with the primæval monster Tiamat, when Marduk slew the great dragon which burst with "great winds." An Assyrian cuneiform inscription in the British Museum, called the Nebuchadnezzar Stele, contains actually a zodiacal calendar of the date with a great serpent sprawling up one side of the stone, and may be interpreted as relating to a period of from 9,500 to 11,000 years ago, but not allowing for a jump due to the new obliquity of the earth, which would lessen it considerably.

146. One further reference should be made to the symbol of the Tau, so closely resembling the veil or envelope of a comet. The Tau is admitted by Count Goblet d'Alviella * and other autho-

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* "Migration of Symbols."

rities * as the predecessor of the Cross, which is itself a symbol long pre-Christian, and the most ancient delineation of Horus, was as a god crucified in the vault of the heavens. In the Apocalyptic books, containing references to a definite event, but placed usually in the future tense as the circumstances were deemed certain to recur, the catastrophe in question is related in this order :

(*a*) " A sword falls from heaven "—appearance of the comet.

(*b*) All see " a fiery chariot and a (fire) brand in the sky "—a twin comet.

(*c*) There appear " a bow, a horn, and a (fire) brand "—the comet was producing curves and jets.

(*d*) " A luminous cross brighter than the sun " —the Cross signified the Tau, both emblems signifying destruction and renovation. In this sense it means that the comet was approaching the earth and gave the illusion of a great fiery cross as it came nearer.

(*e*) " A great star burns up the ocean."
" Stars fall ; the Sun's light is suppressed."
" The fire consumes both earth and water."
" The lightning descends."
" A fierce fiery storm lasts for forty days."†

Here are the effects of a vast appulsion lasting for forty days, and the memory of which was the real origin of Pentecost.

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* Notably, W. Williamson : " The Great Law," etc.

† W. Bousset : " The Antichrist Legend," pp. 232–240. Bousset, in this very valuable record of a remarkable period, states that the antiquity of the belief is as ancient as the duration of the recorded time (p. 132).

A great deal of ancient Bible and classic history or pre-history is entirely misunderstood because chronology is demonstrably wrong both in years and sequence. This cometary impact of Phæton is the key to all ancient history and also to ancient geography.

PHALLIC WORSHIP WAS WORSHIP OF COMETS

147. It is impossible to attempt to reconstruct ancient history in this particular work, although sooner or later an entirely new light must be thrown upon it, by the prosecution of such scientific analyses as outlined here, but in view of the importance of the ancients' knowledge of the heavens and the relationship between the comet, the meteor, and the volcano, it is relevant to revert once more to phallic symbols and to their true meaning. Avebury Temple provides an object lesson that can be seen to this day in its ruined state of the reverence and awe with which the builders regarded meteoric stones. At Piggle Dene, a mile and a half to the east of the great sanctuary itself, many of these stones are still *in situ* as they fell and are called " grey wethers." The builders took these stones, many of exceeding great size weighing many tons, and set them *upright* to form stone avenues leading from Hackpen Hill (meaning the Head of the Serpent, now called Overton Hill) to the Temple, a circle with a

vallum or wall three-quarters of a mile in circumference, where they erected a gigantic circle of 360 stones and carried another avenue of stones *all set erect* beyond an existing trio of tones called the Devil's Quoits to the west.[*] The exact architecture of this vast monument has been disputed by Cox and others, but admittedly the Temple consisted of 360 stones, with two inner circular temples of thirty stones and twelve stones, also making 360, if we regard it as an astronomical monument. Five stones appear to have been added later. It is a natural inference that this huge serpentine temple was first erected when the year consisted of 360 days, *and thus may have been prior to the Phæton catastrophe.*

147A. All these stones are of grey silicious limestone and are obviously of meteoric origin. It is generally supposed that the builders lived in the Neolithic Age and were without the tools to dress and chisel the vast stones they thus reverently set up, but sight is lost of the fact that such stones were regarded as holy and the very strictest instructions were issued that no chisel or iron was to pollute them.[†] Undoubtedly the Israelites offered up human sacrifices in such temples to comets which threatened them. References in the Old Testament to this practice are translated by the word " devils," the Hebrew word being Seirim or Shoirim, but the Revised Version renders it correctly as " he-goats," and in the margin as " satyrs." The Jewish rabbi Maimonides says that the Sabian astrologers worshipped these Seirim or Goats, meaning thereby meteors. We learn,

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[*] Stukeley.

[†] See Exod. xx. 25; Deut. xxvii. 5; Josh. viii. 31.

> They [Canaanites] sacrificed unto Goats, not unto God; to gods whom they knew not, to gods that came newly up (Deut. xxxii. 17).

147B. In the days of Rehoboam they were building temples in which it appears they put carved stone images after the style of the Avenue of Sphinxes at Karnac in Egypt :

> And he [Rehoboam] ordained him priests for the high places and for goats and calves which he had made (2 Chron xi. 15).

Much more might be said on this aspect. Aaron made images of golden calves at Mt. Sinai, a volcano, for the same reason, and Mt. Seir, as the passages show, Goat Mountain, was another volcano. " Little goats " is still a term employed by the Spaniards to indicate meteors, and comets or meteors, " gods that came newly up " were the centre of a cult which as dolmens and cromlechs, pillar stones and round temples of upright stones yield evidence, prevailed throughout Europe, particularly in the British Isles, Brittany and Normandy, and are traced as far afield as America, India, and even Japan.

148. When Solomon built his Temple in conjunction with his friend Hiram of Tyre he set up a statue to Poseidon, the Tyrian Melkarth, the Earthquake and Meteor Sender. The text is

corrupt, but it appears that in the huge basin, supported by twelve bulls, was an image of the god driving his chariot of six winged horses, while fifty Nereids riding on dolphins escorted him over the deep. Solomon " went after " Ashteroth or Astarte, the Egyptian Isis, which is scarcely surprising since the Temple was not only a place of worship but also an observatory. The two great brass cylinders, over 36 feet in length, Hiram cast for him, which were kept in the porch, are believed to have been telescopes. The temple was adorned with palm trees, pomegranates, lotus work, and various emblems of a phallic order. Ashteroth was the female of Asher (*i.e.*, straight, erect, a phallus, says Wheeler in his " Bible Studies ") and *asherâh*, sacred to her, dedicated accordingly to her, were upright pillars or pillar stones which, when we understand the relationship between a meteor and a volcano, is not a point very obscure. Ashteroth represented the female principle of the cosmos, and it is in accordance with the science of meteorology that the goddess Diana or Ashteroth of the Ephesians was represented in a rudely-carved image from a meteoric stone said to have fallen from heaven, like the Astarte of the Tyrians, by whose action in falling to earth the city of Tyre came into existence. The name Astarte is the origin of the Latin word *Astra*, our English word " star."*

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* Many statues of the goddess or of Isis and Horus are carved out of basalt, and being black it is supposed to be a

148A. There is a statue in basalt of the goddess in the National Museum at Naples, a female figure adorned with grotesque symbols of rams, dragons, lions, deer, bulls, and the bee, all figures having a relation to comets. She has a necklace of grape and a great number of paps, indicative of volcanoes. It is in fact as an emblem of earth that Ashteroth is represented and not in any way, as usually thought, as representative of the moon, although the moon, as the satellite of our earth, is often employed as an adornment to the goddess in the form of a diadem or tiara. All these figures of Phœnician invention depict astronomical science ; the balls and pomegranates as meteors, the lotus as spiral movements, the *asherâh*, like the erect palm tree, or the serpent, in their different forms illustrative of the phallus, in reality the meteor that strikes.

This disguised form of science, obscene or primitive, as many imagine it to have been, does represent in actuality the whole principle of creation and renovation, of fructification and birth, not merely of human beings or the various orders of being, although nearly all of them in their way reflect some trace of their origin, but of the creation of worlds in general and of our world in particular. Throughout it all the male or meteoric means is creative, the female or volcanic means is receptive

proof of the black or African origin of the ancients who made gods in their own image. The reason is simply that basalt is a rock of meteoric origin. Homer depicts the gods as having usually golden or red hair.

and productive. So marvellously is this law preserved throughout that from the highest to the lowest animal creations we discover all energy, all genius, all initiative, practically confined to the male species. No artificial efforts can overcome or circumvent it. Woman, on the principle of creation, without the power in herself to demonstrate the divine afflatus (except indirectly as a mother) while possessed of many compensating and noble qualities and being nearer to the earth, is more in contact with nature. Thus, it perhaps happens that human genius, an abnormal manifestation of some facet or another of the divine spark, appears to be limited in its application to the male gender. It is as though it were itself a human application of one of those meteoric celestial flashes which momentarily illuminate the heavens —a form of dynamic force, evanescent and yet enduring—and die out.

CHAPTER X

THE MYSTERY OF THE DRIFT

DEDUCTIONS FROM STONES

EVERY stone conveys history, but few geologists seem to be able to trace its pedigree. Rocks and stones, igneous or water-formed, the till, boulder clay, and the peculiar formations labelled as unstratified drift, because they defy geological theories, all bear testimony to certain tremendous upheavals forming milestones in the history of the earth.

From the relative positions of various strata geologists profess to define how and when (estimated) occurred the various changes that have taken place on the earth's surface. Their methods are, of course, inference from the after effects of events, but as yet geology has made the fatal error of attributing such events to the internal activity of the earth, presumed to be in a state of incandescence, and scarcely or ever to external agencies. This naturally stultifies conclusions and renders many theories absurd, but fortunately there is a growing tendency towards expansion among this conservative body of thought.

THE BRITISH ISLES BEFORE THE ICE AGE

150. Apart from the causation of certain well-defined geological epochs, beneath certain accumulated strata, are found the petrified or fossilised remains of animals or plants which were living at a time when they were suddenly buried beneath the accumulations. The nature of the particular species thus revealed enables the geologist to determine therefrom the character of the climate at the time they were thus enveloped. For example, water-lilies of a sub-tropical variety have been discovered within 8 degrees of the present North Pole, and whilst this does not by any means imply that there was no arctic circle—for the Pole may have been elsewhere—it does prove that at the time in question places like Spitzbergen, Scandinavia, Greenland, and the British Isles enjoyed a climate graded from sub-tropical to tropical,* yet this was so comparatively recent as to have existed during the late Tertiary Age. In the neighbourhood of London there are indications of a sub-tropical climate, for fossils of the sabal palm, ebony, laurel, oak, almond, plum, beech, elm, fig, vine and other trees, when the red deer, rhinoceros and mastodon roamed the forests, are discovered before the Ice Age which exerted so enormous an influence on the climate in the north.†

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* Edward Clodd : " Primitive Man," p. 22.

† H. G. Seeley : " Earth in Past Ages," pp. 179–192.

IRREGULAR ACTION OF GEOLOGICAL EPOCHS

151. One remarkable fact stands out from these investigations, namely, that these periodic and colossal changes were not universal or even regularly distributed. It is significant to observe that the later overturns in the Northern Hemisphere were not reproduced in the Southern. There was a day when the fern tree and the lemur were common to the Northern as to the Southern Hemisphere, until by some dramatic circumstances, while they were obliterated except as fossils in the north they yet survived and continue so to do in the Antipodes. Australasia can boast of many early species of fauna and flora which long ago disappeared in the north and contrariwise the Northern Hemisphere can boast of geological episodes entirely unknown to the Southern. The course of these various epochs betrays many eccentric features and inequalities.

EVENTS IN THE DRIFT AGE

152. The last great milestone is known variously as the Post-Tertiary, the Quaternary, the Pleistocene, the Drift Age, or the Ice Age. It coincided with a period when a great part of Europe is deemed to have been afflicted with a vast invasion of ice, mountains of ice, following suddenly upon the subtropical climate before. Geologists declare that the period was distinguished by the sinking of many lands. Terrific convulsions shook the earth, old lands disappeared beneath the seas, mountains

vanished in some parts and sprang up in others. Yet this gigantic upheaval left the Southern Hemisphere directly unaffected.

153. De Lapparent, the foremost of French geologists, has remarked of this Age :

> The end of the Pliocene and the major part of the Pleistocene have been marked by a succession of sinkings of which the definite result has been to open between Europe and America the pit of the North Atlantic. . . . From that, perhaps, a vague memory has been preserved in the memory of the first men and gave place in changing to the legend of Atlantis.*

Alluding to the same epoch Paul Combes *fils* says that the North Atlantic must have been occupied by one or more lands.†

Professor Heer, in his survey of the Drift Period, which as he explains was that period of the Pleistocene Age when the " succession of sinkings " occurred, connects the building of the Alps or a part of it with the same age :

> Probably the depression of the Great Miocene continent, which has been designated under the name of Atlantis, was contemporaneous with the elevation of the Alps, and the sinking of the land continued till the close of the Drift Epoch . . . the present boundaries of the Mediterranean were only settled during the Drift Epoch.‡

154. Suess, the German geologist, has attempted to reconstruct the Northern Hemisphere before the Ice Age, and it is interesting to note that just where he shows water and land connections, there too, do we find the definite traces of that very early

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* " Traité de Geologie," pp. 1392–1393.

† In *Cosmos*, June, 1910.

‡ " Primeval World of Switzerland," vol. ii., p. 224.

civilisation (yet one extremely finished) of the cromlech and dolmen builders.* T. W. Rolleston has mentioned that if a line be drawn from Varangar Fiord diagonally across Europe to the mouth of the Rhone, with few exceptions all the dolmens lie to the north of that line.† Mosso traces also tracks of these dolmens from the British Isles to Brittany, along the Rhone to Sicily, Sardinia, Corsica, and Italy, and thence to Algeria and Morocco, while another path comes down from Brittany to Spain.‡ The agreement between the course of physical geography as outlined by Suess and also Heer, with the roads followed by the dolmen builders—Suess traces a direct waterway from the English Channel to the Rhone—presents of itself a *primâ facie* case that these people of the Neolithic Age were existing before this tremendous change materialised.

A Sudden Visitation

155. Across the Atlantic at this same epoch Canada was closely connected with Greenland. The geological formation of the North American Continent with its schists, clays and old red sandstone corresponds (Suess continues) with the same regions of the Old World. That there was a land link at some former time is proved by the fauna and flora. The mammoth, the musk-ox, the elk,

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* Suess: "Face of the Earth."

† Rolleston: "Myths and Legends of the Celtic Race."

‡ Mosso: "Dawn of Mediterranean Civilisation."

the red deer, and many other species of mammals now extinct, or found only in one continent, were formerly common to both. The question is what circumstances combined to cause the musk-ox and Irish elk to become extinct in Europe, the mammoth on both sides, " the simultaneous disappearance over vast areas of whole communities," to quote Suess ? The frozen body of an antelope has been found within the arctic circle and death had been so sudden that the food in its stomach was not digested.*

156. This visitation was sudden as the evidence of the antelope suggests. It was not only sudden in the sense that the animal had not even had time to digest its latest meal, but it was accompanied by a sudden and phenomenal change in climate, for at the time it took place antelopes dwelt within the Arctic Circle, and yet their presence denotes a mild and warm climate. The same principle applies to the mammoth whose remains have been found in Canada, in the British Isles, and in Siberia. In March, 1908, the Petrograd Academy of Science despatched an expedition to excavate the remains of a mammoth discovered near Kasachia in Northern Siberia, and the remains were in such an excellent state of preservation, in spite of thousands of years of " cold storage," that a portion of the flesh was salted, cooked and eaten by members of the expedition. A frozen rhinoce-

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* Major J. Samuels, V.O., in *Chambers's Journal*, February, 1918.

ros was also found in Siberia, a denizen as all know of the hot steaming jungles. From the condition of the body when found and from the fact that the blood-vessels of the head were discovered by Professor Brandt to be filled with red coagulated blood, the Rev. D. Gath Whitney maintained that this discovery and others like it " are opposed to all our notions of natural history." The rhino, he contended, was drowned and preserved in the ice which immediately formed. There is a hitherto unexplained mystery to account for this presence of and sudden destruction of a great mammal belonging to a tropical climate. He says :

> We must remember that this extinction took place in comparatively recent times and that the animal disappeared from North Asia long after the appearance of man on the earth. . . . We are face to face, then, with a mystery, and it is clear the extinction of the rhinoceros all over Siberia must have been brought about by some unusual and tremendous cataclysm, accompanied by an extraordinary change in climate. . . . Thus perished the Siberian rhinoceros overwhelmed by a catastrophe both sudden and tremendous.*

Commenting on the above, Major J. Samuels, V.D., in an article concerned with the subject ascribes the fate of this rhino to the Glacial Age, and he remarks that whilst the Glacial Age is a fact, its cause is still a mystery :

> By what means the land surface of this globe has been broken up into its present form is another problem. The varied position of boulder stones, of all sizes from hundreds of tons to small pebbles, is a geological puzzle to-day.†

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* In *Chambers's Journal*, February, 1914.

† *Chambers's Journal*, February, 1918.

157. The bones of the mammoth are not infrequently discovered under the Drift, particularly in Scotland, where at the time he haunted the primæval forests. In an old quarry at Woodhill, Kilmauns, Ayrshire, under thick boulder Drift, were found some years ago the relics of at least eight mammoths, as also, under the same deposits, the remains of extinct species of red and fallow deer. A head and horns of a fine elk recovered from a marl pit in Perthshire are preserved in the Hunterian Museum, Glasgow, and the elephant has been found under till on the line of the Union canal. The Rev. F. Smith, the authority for these statements, says there is evidence of seventeen or eighteen different elephantidal finds north of the Scottish border in conjunction with the Irish elk (*Cervus megaceros*) and other extinct species of the larger mammalia. All these remains are deposited either under what are called the till or boulder clay, a formation of stones and clay peculiar to the Drift Period.*

DRIFT AND CHANGE OF CLIMATE

158. The Drift marks an epoch which left its traces over an extended area, and, with one exception, nowhere was it more widely spread or so violent in its effects as in the British Isles. It coincided with a remarkable change in climate and considerable alterations in the physical conditions of at least a part of the Northern Hemisphere.

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* Rev. F. Smith : "The Stone Ages," pp. 360–361.

Professor Heer describes it as the period of the Flood :

> During its course many modifications of climate occurred and exercised a great influence on the constitution of the flora and fauna . . . a peculiar character belonged to the epoch from the enormous masses of water produced by active condensation, originating mighty glaciers, and from the elevations and depressions still frequently modifying the limits of their part of the world. It has been well defined as a period of inundations.*

159. Ignatius Donnelly, who alone among investigators seems to have boldly stated that the Drift was the residue of a comet, describes the phenomena of it in graphic language :

> Animals were slaughtered outright and so suddenly that few escaped. . . . Drift fell as a sudden catastrophe, stones and boulders alike are scattered higgledy-piggledy, pell-mell through the clay. . . . The Drift marks probably the most awful convulsion and catastrophe that has ever fallen upon the globe. The deposit of these continental masses of clay, sand, and gravel, was but one of the features of the appalling event.†

160. The explanations offered by distinguished geologists to account for this are all contradictory and unsatisfactory. They agree generally in propounding the doctrine that the Drift Period was the result in some way of the action of ice. They ascribe it to the movements of ice-fields, or to glaciers on a mighty scale, or to a vast ice sheet which spread south from the Pole. Enormous

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* Primeval World of Switzerland," vol. ii., pp. 224–229, 264.

† " Ragnarok," pp. 49–51.

masses of ice, according to this theory, spread over the Northern Hemisphere, carrying with them great quantities of rocks, till, boulder clay, gravel, sand and other materia, torn from their original beds by the ice pressure and deposited where we now discover them.

161. Geologists usually incline to the belief that there was more than one such Ice Age. Some argue that the till was deposited earlier than the boulder clay, and contorted Drift found mainly upon the east coast of England, but others contend that the till merges into the boulder clay, and infer from this a definite continuity. To explain these terms it may be said here that boulder clay consists of large and rounded stones or rocks of different sizes, their edges all blunted, and found embedded in clay. The till is another form of boulder clay, distinguished by its very stiff, closely-welded particles, the stones being usually smaller and more striated or scratched or grooved than the ordinary boulder clay. So stiff is this till that railway engineers and others in Scotland, where it is mainly found, have said that they would prefer to excavate through the solid rock than it. The unstratified Drift is an accumulation of boulder clay, rock, gravel, sand, and clay, not in beds or in regular layers, but spread in confusion, with no apparent order or system.

162. The till is one of the peculiarities of the Drift; the following extract in regard to it from Sir Archibald Geikie's work will not be misplaced :

> The till is spread in broad but somewhat ragged sheets through the Lowlands, continues across wide tracts, whilst in the Highlands it is confined principally to the valleys. . . .
>
> The lowest member (of the drift) is invariably tough, strong clay called " till " or " hard-pan." It is hard to say whether the till consists more of stones or clay. . . .
>
> In describing the till I remarked that the irregular manner in which the stones were scattered through that deposit imparted to it a confused and tumultuous appearance. The clay . . . is distinctly unstratified.*

The boulders in the till are very numerous, not invariably rounded, yet not angular, not very large, but without exception deeply striated or grooved. The boulder clay sometimes contains very large boulders, as at Bradford, Mass., where one such stone is estimated to be over 2,000 tons in weight, and at Whittingham, Vermont, with a bulk of 30,000 cubic feet. Sometimes the till and boulder clay pass into one another by insensible degrees. The clays in which these stones are embedded are varied, being blue, purple, brown, or yellow, and are entirely foreign to the surrounding strata where they were deposited.

163. It was previously mentioned, in regard to meteors, that Geikie traced some phenomenal results dating from the Tertiary Age, and there are the strongest reasons for the belief that the basaltic flow which deluged an area of so many thousands of square miles (43) was also simultaneously accompanied by this phenomenon of the till and boulder clay. It is highly probable also that the same period, if not event, was largely responsible

* " Great Ice Age," pp. 6, 7, 9, 21.

for our coalfields, and for the presence of amber, and thus the Drift Period remains an epoch whose devastating effects are apparent at every turn although its cause remains a profound mystery.

CHAPTER XI

WHERE THE COMET FELL

GEOLOGISTS' STRANGE IDEAS ON THE DRIFT AGE

THERE is little in common with the views of geologists in regard to the Drift, and the conclusions reached in this work. Much as astronomers talk lightly of a comet having an orbit of 100,000 years, so do geologists talk of an Ice Age or several Ice Ages, with sub-tropical interludes between, and ascribe a period of anything up to 600,000 years for the prevalence of this Ice Age, associated with the Drift. It was a sudden and violent episode which in the main lasted only a few hours, although its active effects continued more or less intermittently for a great period. It is difficult to see how any geologists can place a term to it, since their whole assumption is based on an initial fallacy. A writer in recent years, discussing the new theories on geology, says that a leading Swedish geologist has produced overwhelming evidence of an Ice Age in Scandinavia not more than 15,000 years ago, and traces of a smaller, minor one about 5,000 years back.*

165. The old idea still prevails. To account for phenomena otherwise inexplicable they assume that

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* Dr. W. A. Sturge : *Outlook*, January 18th, 1913.

the northern parts of Europe after enjoying a mild, warm, and sub-tropical climate, experienced an age of violent storms, floods and bitter cold, whereby the British Isles and large parts of the Continent were buried under vast accumulations of ice. This Ice Age was succeeded by another period of warmth and sub-tropical produce, all the different varieties of animals, birds, insects, trees, flowering plants and vegetables having miraculously survived these extremes. Once more there fell—some say several times—the icy mantle over continents and once more the various types survived. Some geologists credit the Ice Age with three periods, others six or more, and some do not hesitate to spread this extraordinary period over hundreds of thousands of years. All these theories are based on the assumption of geologists that the Drift deposits were brought in some way connected with ice, and all their theories are accordingly governed by this view.

CHARACTER, DISTRIBUTION AND ACTION OF THE DRIFT

166. The ice theory appears to be based mainly on two grounds. Firstly, it is the only possible way by which those who assume the Drift to be more or less moraine can account for the carriage of enormous weights. Secondly, most of the rocks and stones are found scratched and polished, which is ascribed to friction and pressure caused by icebergs, glaciers, or ice sheets, as they scraped

and ground their way over the land. Sometimes these striæ are deep and clean as though the stones had come into contact with very sharp and very hard materials. The till, most torn and striated of all, is assumed to have been material clinging to the ice sheet, and in its passage grated heavily over pebbles and stones, which thus grooved and scratched them. Why in such circumstances the till or boulder clay continued to attach itself to the ice is an insuperable difficulty to this theory.

167. Not uncommonly the Drift includes blocks of rock of considerable size, striated and grooved, and sometimes found balanced or perched in more or less inaccessible positions on mountain tops or sides, and occasionally on rock pinnacles, as in the Pass of Llanberis, Wales, or in certain parts of Cumberland or Scotland, where neither icebergs nor glaciers could possibly have deposited them. Some of these considerable particles weigh hundreds of tons, but are supposed to have been driven up to the mountain heights by the pressure of ice upon ice, and when the glaciation disappeared they still remained perched up on those inaccessible heights.

168. The Drift in certain localities is of considerable volume and depth and is especially curious by reason of its erratic distribution. For example, the granite Drift of Kircudbrightshire is found in Lancashire and North Wales ; the Westmorland shap granite is also discovered in the Plain of York between Whitby and Scarborough ; Cumberland

has the same boulders as the igneous strata of Cheshire ; Lincolnshire and Yorkshire reveal similar deposits as the London area, and boulder clay on the Norfolk coast near Cromer is duplicated in Norway. These eccentricities which have puzzled geologists are only explicable by the theory that a body or bodies came from the north-east or north and covered so wide an area that Scandinavia and Cromer, and the various places mentioned where the Drift fell in its contorted forms, were visited simultaneously. If it were possible to examine the bed of the North Sea, beneath the accumulations of sand, shingle and clay it would probably reveal a more or less continuous path of this classified and unclassified Drift strata.

Drift Materia Contains no Organic Traces

169. Another characteristic of the Drift is that it contains no signs whatsoever, the chalk excepted, of any former living entities either fauna or flora. This is very positive proof that the Drift could not have been existing terrestrial strata torn away by the action of ice from its original situation and carried forcibly elsewhere, for in such circumstances it would have surely brought with it a certain amount of moraine, trunks and boughs of trees, skeletons of existing animals or fish or at least a few traces of pre-existent life. Yet it contains nothing, not even fossils, although there are copious examples of all these materia in the soil and rocks on which the Drift fell. It has been contended

that the chalk is itself a refutation of the assertion that the Drift contains no evidence of pre-existent life as chalk consists of the powdered shells of former mollusca. This is undoubtedly true, yet it actually serves to strengthen the case against the terrestrial origin of the Drift, for these shells must have been subjected to influences quite distinct from mere hydraulic pressure to have reduced them to vast deposits of solid chalk or of chalky boulder clay (*i.e.*, chalk, stones, and clay) found on the east coast of England covering the contorted Drift. The heavier materia—the contorted Drift—fell first, and the lesser materia, falling together, formed this chalky boulder clay.

169A. We discover chalk, like sand (the disintegrated remains of greater rocks), forming elevated plateaux or heights sometimes very solid and continuous, as at Moel Tryfaen, Carnarvonshire, along the Marlborough Downs, and in Kent and Sussex. When we find the chalk inland, where no proofs of any pre-existent sea survive, how can the residue of former untold æons of countless shelled creatures have been collected together over one specified area, ground down into powder, welded into one heterogeneous whole, and left there ? Not by any process in which the earth unassisted plays a part. How could chalk and chalky boulders be carried to a spot, say, in Wiltshire, an inland country, to form a solid strata spread over a greater surface than all other strata combined, with a total average depth of over

1,000 feet, containing a large number of rounded dunes or hills nearly 1,000 ft. in places above sea level? There is and can be only one explanation to account for this succession of circumstances. The mollusca were subjected to extreme fusion and disintegration, part forming the clay and the shells, fused in the form of chalk, fell upon the localities where we now find them. Donnelly sums up the whole problem of the Drift in these words:

> It is plain that it was the result of violent action of some kind. And this action must have taken place upon an unparalleled and continental scale. A remarkable and stupendous period—a period so startling that it might justly be accepted with hesitation were not the conclusion inevitable before a series of facts as extraordinary as itself.*

Such are the circumstances in brief. Geologists seek to explain them by one of four varying theories in general, as follows: (1) the Drift was caused by the action of great waves and floods; (2) by the action of icebergs; (3) by glaciers; (4) by a continental ice-sheet. It is necessary to examine these in order.

WAVES AND FLOODS THEORY TO EXPLAIN THE DRIFT

170. Sir A. Geikie scornfully criticises this theory in the following words:

> Somehow and somewhere in the far north a series of gigantic waves was mysteriously propagated. These waves were sup-

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* Ignatius Donnelly: "Ragnarok," p. 7.

posed to have precipitated themselves upon the land and then swept madly over mountain and valley alike carrying with them a mighty burden of rocks, stones and rubbish.*

These waves must have also been so enormous as to sweep over the tops of high mountain ranges, for evidences of the Drift are discovered 3,000 feet above the Baltic, 4,000 feet in the Scottish Grampians, and 6,000 feet in New England, U.S.A. As evidence of the Drift is also found as far away as Brazil this flood and storm in the far north must have increased if anything in strength when it reached North and South America. It is inconceivable that such waves could have reached such heights; but had it been possible, how was it that they did not deposit any shells or moraine on these heights, and how was it that none of the Drift contained any trace of fauna or flora? The theory fails to explain the striæ on stones, for if waves were the sole cause of the Drift the stones of the seashore would especially reveal the gashes or scars caused by the collision of stone hurled on stone. Generally, such is not the case. However, the above theory is now practically abandoned.

THE ICEBERG THEORY

171. This theory pre-supposes that icebergs in vast numbers floated in deep water over the submerged land and brought with them great quantities of *débris* from the arctic shores. As Geikie remarks, when a berg drops its rubbish the heavier

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* " Great Ice Age," p. 26.

portions must reach the bottom first and the finer particles last, whereas this is by no means the case with the Drift. Croll remarks that icebergs sail down into the oceans without a scrap of *débris*. Leaving aside, however, some unaccounted method which caused the icebergs to load themselves with the materia, we have to premise a situation where the icebergs were driven with enormous force over the bottom of the sea in order to cause the striations, and yet this *débris* remained attached to the ice until at length it was left high and dry on the land. In actuality, once an iceberg grounds it remains until it rocks itself to pieces or else melts away, so in either case there would be no grooving. This theory becomes the more absurd each moment it is further examined, for the striated stones, to explain which the iceberg theory was invented, are found along the mountain sides, on the summits, in the deepest valleys, cover a very considerable area, and disappear under the waves of the sea.

THE GLACIER THEORY

172. Necessarily limited in numbers and restricted in their field of operations, glaciers are totally inadequate as the cause of the Drift *débris* covering hundreds of thousands of square miles. Glaciers do not produce till or boulder clay, do not create striated stones, and could not have existed on the highest mountain peaks where we do find striation. Geikie disputes this theory also by the

statement that the scratched and polished rock surfaces are met with everywhere at all levels. "The lower hill ranges such as the Sidlaw, the Ochils, the Pentlands, the Kilbarchan, the Paisley Hills and others exhibit polished and smooth rock-surfaces on their very crest." * In addition, Drift is found in certain great continental plains far remote from any mountain ranges.

GEIKIE'S CONTINENTAL ICE-SHEET THEORY

173. This was Geikie's pet theory, and the one most generally accepted as the explanation of the Drift. In effect it is a hypothesis that the whole north and south regions of the world, extending some 50 to 55 degrees from the Poles, were covered with enormous, continuous sheets of ice from one mile thick at its southern margin to three or five miles thick at the Poles. No attempt has been made to account for the enormous quantity of water accumulated within the latitude of the Poles thus congealed into a vast ice field or belt embracing more than half the entire world. Nor does such a quantity of ice account for chalky boulder clay, or the till, or the boulder clay. It does not even explain away the striated stones. It is assumed by Geikie that the passage of this mighty ice-sheet tore the stones and soil as it moved south. But this does not explain why ice should manufacture the peculiar qualities of the till and boulder clay. Such action as Geikie pre-supposes would provide

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* "Great Ice Age," p. 26.

moraine materia, but it would not have manufactured the tough stony till or boulder clay.* Rather it would have disintegrated them.

174. Why, too, should such an ice-sheet move south ? Certain mountains in Northern Asia and Northern Canada and Greenland are covered with large ice-sheets, but they do not move south. They stay where they belong. To account for this southern movement another theory has to be invented, namely, that Northern Europe and America were elevated 1,500 feet above their present level, forming a huge plateau down which the ice-sheet slid. Croll, an authority on such questions, said that the facts of geology are fast establishing the opposite conclusion.† Observation of this aspect of ice-fields has shown to-day that they do not move with a constant grinding movement towards the south, but rather break off like great icicles by their own weight, and they do not cause striation. The scratchings and groovings of the drift and its absence from stones in the vicinity of ice-fields to-day is an important objection to the ice-sheet theory. Geikie holds that the scratchings were caused by the weight of the super-incumbent rocks, which tore up, ploughed up, ground and smashed the surface

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* Professor Boyd-Dawkins says : " No similar clays have been proved to have been so formed either in the Arctic regions where the ice-sheet has retreated or in the districts forsaken by glaciers in the Alps or Pyrenees " (" Early Man in Britain," p. 116).

† " Climate and Time," p. 391.

rocks. Had this been the explanation the scratches would have been more evident when the ice-sheet was pursuing its greatest momentum downhill, southwards. But in point of fact the striations are more numerous on the north side of mountains than on the south side.* Here, then, we discover an ice-sheet which rushes violently uphill and crawls down !

175. The most unanswerable objection to the ice-sheet theory is that there is no Drift in Siberia or in North-West Canada. The ice-sheet which stretched from about Spitzbergen westwards, in the direction of the south-west, did not affect Siberia or Alaska and the Canadian arctic zone ! Geikie attempted to meet this problem by assuming that the climate of Siberia and North-West Canada was too dry to furnish snow to manufacture the ice-sheet. Donnelly remarks of this :

> The explanation is more extraordinary than the thing it explains. One-third of all the water in the oceans must have been carried up and was circulating around in the air, enough to form a layer of ice from one to three miles thick and yet none fell in Northern Asia and North-West Canada ! †

176. Such a vast accumulation of ice as Geikie required to enunciate his theory could only have been assembled if the temperature of the earth were lowered to hundreds of degrees below zero at the Poles. In these circumstances 35 to 40 degrees would have been considerably below normal, the equator would perhaps have fallen below

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* Dana : "Manual of Geology."

† Donnelly : "Ragnarok," pp. 29, 30.

freezing point, and a great number of sub-tropical and tropical animals and plants would have perished. Yet the geologists allow intermittent periods of Ice Ages and sub-tropical! As Drift deposits are discovered in Brazil and Western Africa; in the Sahara, acording to H. W. Haynes; in the Gulf of Mexico, according to Dr. Winchell; in North America, where it is patchy, not reaching beyond Iowa in the opinion of most authorities, it can be seen that it nevertheless is discovered in latitudes whence even Geikie's vast ice-sheet could not have penetrated unless it reached the equator, although in these places it is only a scarce phenomenon.

NO DRIFT IN SOUTHERN HEMISPHERE

177. On the other hand it is not found in the Southern Hemisphere. How is it that this vast ice-sheet, with its tremendous effects, escaped Australia, New Zealand, Patagonia and the other southern lands? If it took place through a change of climate over thousands of years it must have been reproduced in the Southern Hemisphere also. With the significant absence of any Drift in the south, added to its absence in the coldest lands of the north, namely, Siberia and North-West Canada, it can no longer be a tenable theory that it was caused by an ice-sheet or by any glacial agency whatsoever. When the Drift is found where the hypothetical ice-sheet could never have penetrated and is absent from great areas where on

Geikie's theory it must have been, while it fails to explain the very purposes for which it was invented, it is evident that it fails of its purpose. The Drift was not caused, and could never have been, by floods, glaciers, icebergs or an ice-sheet. There was never an Ice Age, although undoubtedly the origin of the Drift caused enormous floods, and owing also to a tilting of the earth's axis brought regions hitherto temperate within the arctic zone, whilst it is further possible that the effects of the catastrophe in question did result in a period of most severe winters.

Drift was Rained Down

178. The effort to explain the Drift by any terrestrial agency is hopeless. The destruction rained on certain of the northern lands did not originate anywhere else than from the skies. The event was both violent and sudden. It visited the highest mountains and the lowest valleys, struck the resisting heights from the direction of the north or from the north-east, rained like a storm of sleet, much of it in a state of fusion or semi-fluid mass draining down the elevations and filling up the hollows. It struck certain heights with such violence that it loosened many peaks, leaving here and there *blocs perchés* as witnesses of its advent, and part of this same great cometary body left chalk and sand in the rolling downs and hills discoverable in so many parts of Britain. It fell in varying forms in different localities, as might be

expected, such as the red crag in Scandinavia and in Norfolk, followed immediately by the boulder clay. Flints, by constant collision, split into flakes (often supposed to have been flaked by early man) were doubtless largely responsible for the scratching and striation of softer stones. The basaltic rocks fell in a certain area amid conditions staggering to the imagination, and gradually solidified in the same way that the granite Drift fell in Southern Scotland, Lancashire and North Wales. Molten clay, white hot stones, gravel and sand and chalk, fused to a temperature beyond all human knowledge, descended in avalanches. It rounded the boulder stones and deposited these with the clay or chalk.

179. Knowledge of this portentous event was most certainly preserved to man, for it marked a vast epoch in the world's history. A very significant geological description of this very occurrence —or one like it—is preserved in the Mexican Chimalpopoca, a record far too little known like other American antiquities. It says :

> The third sun that displays itself, it is said, on the day Nahui-Quiahuitl, Four Rain, is called Quia-Tonatiuh, Sun of Rain, because on this day fell a rain of stones of gravel. It is said, whilst these stones thus were poured forth, the tetzontli boiled, and the rocks of red colour were formed.
>
> Now it was in the year Ce-Tecpatl, one Silex ; it was the day of Nahui-Quiahuitl, and the third Nahui-Quiahuitl or Four Rain. Now, in this day men were lost because of the rain of fire and they were changed into geese, the sun even burnt, and all was consumed with the houses.*

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* Abbé Brasseur de Bombourg's " Popol-Vuh."

It can be seen at once that the author of the passage is giving an actual date, the year, month and day; and he describes a "third sun," evidently an expected comet, accompanied by a rain of gravel, tetzontli (basalt) boiled, and red rocks, perhaps the red crag or red sandstone, were formed. The Abbé Brasseur was decided that this event was a world catastrophe: "It presents in reality," he says, "the account of the cataclysm which upset the world some six or seven thousand years ago and constituted the continents in their actual state." *

EFFECT OF DRIFT INSTANTANEOUS

180. The comet's impact—the Drift—was instantaneous in its effects. Over the vast area affected the evolution of animal and vegetable life was suddenly arrested. Certain species were totally exterminated either by being rained on, or by shock, or by exhaustion of air, or by submersion, or, as in Siberia, by sudden glaciation. It descended on mountains and they were no more; it appeared to burn up the very ocean; in a moment cities were obliterated and the habitations of man. It fell on verdant forests and, acting as a vast retort, petrified the trees into coal; it buried beneath the liquid rocks and mud or till trunks of great sub-tropical trees, bones of great beasts which had sought shelter in forest glades or in places where their instinct led them to try to

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* "Quatre Lettres sur le Mexique."

avert the terror; and the vestiges of these, discovered in a far later age, become the subject of learned discourses by authorities upon the Ice Age or the era of volcanic vents in the Tertiary Period. Amongst its after-effects were first and foremost a permanent change in climate, although there seems to be evidence that subsequently the climate was further affected by a similar but infinitely lesser appulsion which affected more especially the North Sea area; secondly, a wide creation of coalfields, especially in the British Isles, where the blow fell with full force; and the minor blessing of amber.

Coalfields Coincident with Drift Age

180A. If the coalfields of the North are studied it will be seen that they are almost entirely limited to the area smitten in the manner indicated. The regions that suffered the worst, such as the Clyde, South Wales, Somerset, Northumberland and the Midlands, produce the best coal, especially South Wales, known traditionally as the Celtic Hades. Scotland, it is true, felt the awful effects still more, but if coal is comparatively rare north of the Clyde it is because the mountainous and rocky soil was not conducive to the growth of the forest trees whose petrified remains in the more alluvial lands of the south we now burn in our ships, factories and grates. Ireland should possess many more coal reserves than are yet discovered. Germany, Belgium and France, farther from the actual heart of this event, possess inferior coal or lignite, at lesser depths and not so highly carbonised, and it is probable that the coal in these countries was produced at a different epoch, and in the case of the Ruhr coalfield earlier than at least the Welsh coalfield. Coal has been produced by similar effects in many parts.

The Effects of the Comet Impact in the North

181. To the phenomena described we should not omit to link up many of the volcanoes traced in the earlier part of this inquiry. But a region closely concerned, where I venture to suggest the residue of the comet may have fallen—although a body like this is necessarily dispersed over a wide area—is Iceland. It is possible also that some day research and investigation in Greenland will reveal remains of a considerable prehistoric civilisation. Greenland, called by the Danes Cronland, or the land of Cronus, appeals dumbly to the attentions of the scientist and the prospector, who might be tempted were he to realise that the Greeks believed Hyperboræa was paved with gold! Investigations in recent years by Sir John Murray and Dr. Johann Hjört, confirming the Wyville-Thomson expedition before them, show very definitely from deep sea soundings that originally Greenland stretched much further south than east, and that Iceland, the Faroes, and Ireland were within easy access of it. The comet that left its residue where Iceland stands in doing so destroyed Greenland, and, by

the resultant adjustment of the earth's axis to meet the new physical conditions of enormous materia deposited mainly in one area, threw Greenland into the Arctic Circle, an inaccessible and lost land.

182. The comet causing the Drift mutilated the British Isles and yet benefited them by its gifts. Its effects were very intermittent, but it is plain enough that all those regions lying nearest to Greenland and Iceland suffered the worst ravages. The Shetlands were once a very considerable island, but it is evident that they, like the Orkneys, were bombarded by meteors, torn by resultant earthquakes, and large portions permanently were submerged. The Outer Hebrides, as the nearest locality to the actual target or centre of impact, Iceland, the Faroe Isles and Shetland Isles alone excepted, were, like these, literally torn to shreds. The case of Benbecula, lying between North and South Uist, has been previously mentioned. This tiny isle, seven and a half miles in breadth and six in length, contains over 150 lochs, mostly small but very deep, also a great number of deep fiords, while off the coast or in the lochs are hundreds of small islets. Although the formation of the islands was lower Silurian with crops of old red sandstone, it now contains great deposits of basalt, and there is some evidence in Benbecula of a volcanic crater having been shattered. It is probable before this violent onslaught that the Outer Hebrides were a heterogeneous mass stretching over fifty miles to the west, and perhaps embracing St. Kilda and the

Flannan Islets. The Faroe (or Pharaoh) Islands, closest of all to the focus of this titanic cataclysm, naturally suffered the worst. They consist of twenty-one isles, with numerous other rocks, and the little we know of them geologically states that they are composed of basalt. Trees no longer grow, but formerly flourished in these latitudes, and at some possibly prehistoric date they were occupied by ecclesiastics supposedly of the Celtic Church. A drowned volcanic crater lies off the Faroe Bank, and Professor Broggar, the Norwegian oceanographer, has expressed his belief that they stood at a higher level during the glacial epoch. This means that they occupied a larger area, and whether their reduction is due to a seismic disturbance of the bed of the ocean or to a vast increase in the water, the result comes to the same thing. Undoubtedly many islands in this area were submerged, some temporarily, others permanently, whence it would seem the origin of the tradition of the lost Pleiades or Atlantic Islands which the subsequent makers of the new calendar placed as a group of stars in the sky, as they did also the River Eridanus, to immortalise the event.

183. A feature of this tremendous impact was its patchiness. While Lancashire, Cumberland, Wales, and across in Ireland, in a direction south-west, was plentifully visited, the Isle of Man escaped except for a patch about Ramsey. It would also appear as though certain mountain heights had been very considerably reduced.

Geologists say that Mt. Snowdon was once seven times higher than is now the case.* It is declared that the Mendips at the time of the Carboniferous Period underwent a change, and that the region was submerged 6,000 feet or more and solid rock washed or worn away.† There is reason to believe that Dartmoor with its vast granitic beds of extinct volcanoes at one time was elevated to heights infinitely greater than is the case now.‡ This catastrophe took place at a time, moreover, not merely when man lived on the earth, but when the British Isles were populated by a race or races of men famous in the world's history, whose records and sufferings have fortunately been preserved, although as yet their application is profoundly misunderstood. Perhaps public opinion is not yet sufficiently ripe for an entire reconstruction of the history of mankind, but sooner or later it must be forthcoming. In spite of not one but two such catastrophic occurrences — though the second mainly operated along the east coast—one of whose results was the emigration of survivors to more kindly regions, the settlements of modern man for the most part are but a continuation of the primordial sites in so far as it is practicable having regard to climate and that guiding principle, commerce. It is the profound conviction of the writer, who can trace the city's history more or less continuously over a very great period, that the city of Bath possesses a long-lost history at once amazing and illustrious, and was a very great city at the time of the Drift. There is a strange but significant barbaric poem extant, entitled "The Ruined City," attributed to the early Saxons, but betraying a knowledge of the lore of Bath, which points to its prehistoric grandeur :

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* E. A. Kilner: "Four Welsh Counties," p. 78.

† F. A. Knight: "Somerset" [Camb. Univ. Press], p. 41.

‡ F. A. Knight: "Devonshire" [Camb. Univ. Press], p. 30-36.

> Strange to behold is the stone of this wall,
> Broken by fate the strongholds are bursten,
> The work of giants decaying ;
> The roofs are fallen, the towers are tottering,
> And mouldering Palaces are roofless.*

184. The type of people who dwelt in Scotland prior to this eventful occasion may be retraced by certain relics which survive. One such exists in the Achnacree Moss, a desolate Argyllshire Moor situated in a region where are found a serpent temple, vitrified forts, stone circles and the like. Sir Daniel Wilson alludes to this Achnacree Moss, known generally as "Black Moss" because of its colour. Rising up through this are several large cairns with here and there remains of others, while in various parts portions of the moss have been cleared away showing at a depth of from 8 to 10 feet the original soil upon which these mounds have been raised. "It is no vague conjecture," says this author, "which refers to an era altogether prior to that of its earliest historical occupants, the period when this wild and barren moor was the scene of

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* Earle : *Trans. of the Bath Nat. History and Field Club.*

life and intelligence and, it may be, of many useful arts." *

185. In 1914 two Scottish archæologists discovered ancient cairns in the Isle of Oronsay, Argyllshire, at the mouth of Loch Sunart (near the Black Moss), bearing traces of the existence of civilised men at a very early date. In 1916 a spacious subterranean dwelling place was discovered by a Scottish crofter when ploughing. The structure is octagonal in shape and is separated from an encompassing wall of the same shape by a passage 4 feet wide and 5 feet high. Both roof and walls were built without mortar, but were very strongly put together, and many of the stones were remarkably large.† Similar structures have been found in Ireland and in the Orklands and Shetlands. In this same area of Argyllshire and the Isles are many vitrified forts, one such being at Rahoy, two and a half miles from Oronsay. How did they become vitrified ? Surely not by the act of man ! On the Isle of Arran are two ancient round temples, and on the Isle of Lewis is an astronomical temple at Callernish, consisting of forty-eight upright stones, a sunk altar chamber resembling the pit in pyramids, in the form of a cross, the point of intersection being enclosed within a circle. The shaft pointing north is 392 feet long, the cross-shaft (or wings) is 141 feet, and the diameter of the circle is 42 feet. " It is impossible," says a

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* " Prehistoric Annals of Scotland," vol. i., p. 91.

† *Pall Mall Gazette*, 17th April, 1916.

recent writer, " not to see in this temple the emblem of Ashur, in which the god is encircled about the waist by a ring." * These temple foundations were discovered under an accumulation of peat moss which must have taken ages to collect. The Isle of Iona, adjoining Mull, is not only the most sacred prehistoric part of Scotland, but it has associations of a strange Egyptian character, its Street of the Dead, and a carving in the ruined cathedral of Thoth or Hermes weighing souls. There, too, are the tombs of prehistoric kings whose very names are lost. Originally also in Iona stood a temple of 360 upright stones as at Avebury. These matters all point to a very ancient and extinct civilisation, whose priests understood the science of the heavens and based their religion on it.

THE EARTH'S ORBIT LENGTHENED BY FIVE AND A QUARTER DAYS

186. Before concluding this research it may be permissible to add a few words in regard to the ancient calendar, for this calendrical year of 360 days is of itself a weighty question. It was previously suggested that the ancient year of 360 days was by the catastrophe (disguised under the name of the Drift) lengthened by another five and a quarter days. In confirmation of this in the Talmud, it is stated that the order of the universe was altered at the Flood and all knowledge of astronomy was destroyed. The philosopher Anaxa-

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* A. W. Whatmore : " Insulæ Britannicæ," p. 213.

goras says that " at the beginning the stars were seen as if carried round in a vast dome, in such a manner that the constant apparent revolution of the heavens was vertical to the earth." He adds, " The inclination it now has was received at a later period." If it had been inclination alone the calendar could have been more easily adjusted, but if its orbit, for the same reason, were increased, fresh days in proportion were added. That such a change is possible in a planet is confirmed by the Roman Varro, called the most learned of the Romans, who said that the planet Venus underwent a great change in the reign of Ogyges. It changed its diameter, its colour, its figure, *and its orbit.*

187. We talk of the Flood when these events occurred, and it would be interesting to ascertain its true position in ancient history. The Bible, in the writings of the greater prophets, Isaiah, Jeremiah and Ezekiel, and particularly also in the second book of Esdras and the Apocalypse of St. John the Divine, describes just such a catastrophe as this " Drift " as having recently occurred or as about to occur. This has an important bearing on the actual period, because both Daniel and St. John the Divine write of a year of 360 days without any five days added. Bible chronology is admittedly on a very insecure foundation at present, and in view of the veracity of its teachings the sooner a coherent and scientific analysis is made into the procedure of its chronology and some practical understanding arrived at the better.

188. After the Flood a new calendar was devised. The seven planets were said to have been in conjunction with the first point of Aries, when the earth was renewed and so destroyed, but whether this was on December 25th, or March 25th, or June 25, or September 25th, is a point not yet decided, although very important chronologically, because each day marks many years in the Precession of the Equinoxes. The feature of the new calendar was that five days were added, for the plain reason that observations showed a lengthening of the days in a year. The inexactitude was no doubt soon perceived, for in six years a month would be thrown out of its place. Observatories like Stonehenge, Avebury, Ben Cruachan (Argyllshire) and elsewhere doubtlessly took measurements of the Sun's position at the equinoxes and solstices to discover if the calendar were correct, or if not how much it erred. Sir Norman Lockyer noted of Stonehenge that it was set up by a race who reckoned time by a sidereal year, like the Babylonians, and who closely observed Sirius. At Avebury, similarly, the stones indicate a learned race of astrologers and astronomers who possessed a 360-day year and subsequently added five more days to it. Canon Bowles asserts in his work on Avebury that the five additional stones were dedicated to Typhon (or Set or Saturn) and the Underworld Deities.* If this be the case it implies that they attributed the five

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* "Hermes Britannicus," pp. 61–62.

days extra to their intervention which occasioned the need of these five intercalary days.

189. Le Plongeon, who made a comprehensive study of Maya antiquities, said that the Mayas of Yucatan divided the year by lunations like the Egyptians, that is into eighteen months of twenty days, to which they added five supplementary days that they considered unlucky. He observes that the Egyptians adopted the solar year of twelve months of thirty days, adding to this calendar five days called Epact, and both Egyptians and Mayas considered these five days unlucky.* Sir Gardner Wilkinson, who stands yet as the greatest authority on Egypt, speaks of the number five as being to this day the evil number in modern Egypt. Professor Piazzi Smyth says it was particularly hateful to the Egyptians. The records of the Aztecs of Mexico, who called themselves the Nahuas (or sons of Noah), describe in their sacred book how a hurricane of a stupendous nature checked the sun in his course, and only a few persons survived who had hidden in caves. The Aztecs had been forewarned by a great prophet and leader, called Hueman in their records, that the star which ruled the destinities of the giants (from whom they escaped) would cause a cataclysm. They set out on an exodus to escape this threatened visitation, and at a place called Huehue Tlapallan assembled to revise their calendar. It seems distinctly probable that the star referred to was Sirius. The five

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* "Vestiges of the Mayas," p. 62.

intercalary days in all cases were a later adjustment of an earlier calendar caused by the alteration to the earth's orbit, which alteration is accountable by the laws of gravity owing to the additional weight borne by this appulsion called by geologists the Drift. Thus, it may be said on the evidence of the calendar that a very high civilisation, reckoning a 360-day year, was brought to a sudden termination or part termination by a catastrophe of the first magnitude.

CONCLUSIONS

190. With these words I bring to a conclusion an investigation which will have performed far more than I dare hope should it succeed in crystallising thought into a consideration of problems that may appear at first sight new and revolutionary but are in truth of extreme antiquity, being the revived knowledge of our remote ancestors. In attempting to solve the Riddle of the Earth we come truly into proximity with the Creator, for what are meteors or comets but His messengers, directed by one great and mighty Will? It has been suggested in these pages that not only are we in contact with Providence who makes and unmakes worlds, continents, islands, civilisations and rulers, as He sees fit, but that cometary gases projected into our atmosphere may and do affect the public health, and perhaps the minds of men sufficiently receptive. It has been shown how tremendous a part the meteor or comet plays in the

laws of evolution, as the male principle, that begets, whilst the volcano is the receptive principle, the mother of us all, and like a mother instinctively senses the dangers threatening her offspring which she seeks to avert.

191. And have we not seen the tremendous effects of a great cometary impact with its influences upon the future of the human race ? To the vast results of such impacts can alone be attributed the various creations. It was possibly during what might be termed the Java epoch that human life was first evolved in the Dubois Man (Pithecanthrobus erectus) of Java, a slight advance on the long-nosed ape or gibbon of Java. These questions are, however, purely conjectural and are beyond the actual scope of this work, although it is of great importance to note that anthropology, like its kindred science geology, must follow in the wake of meteorology in determining the true course of the history of creation in its many vicissitudes. It has long been maintained, not on scientific grounds, but on the assumption that the human race was created in the Garden of Eden and that the locality is situated in the country we term Persia, or Mesopotamia, or Iraq, that the ancestors of the Aryan peoples of Europe came from Asia. Anthropology may claim to have destroyed this delusion for the earliest traces of man in Europe, from the north to the south, reveal the people with dolichocephalic or long heads. The earliest Neolithic tombs of Britain, Sweden and Norway, and the

Continent west of Russia, show the long-headed type. At the end of the Neolithic Age the round-headed or brachycephalic peoples are discovered in a line north of the Himalayas to Warsaw and across to Bordeaux.* Masso says it is proved that Europe does not owe her civilisation to the round-heads from the East, and it never penetrated into Egypt or the Ægean. Professor Sergi also claims that Europe did not feel the influence of the Asiat[illegible]e.† Anthropology, indeed, points definitely to an origin of white men as separate from the black or brown races, and that this creation did not originate in Asia but in Europe.

192. In all these questions meteorology provides the key. If through eternity we may point to one unchanging and immutable centre of stability, never altering, never deviating in so far as it may be perceptible throughout the ages of the world, it is the Pole of the Ecliptic. If it be as contended in the preceding pages of this work that all great cometary or meteoric impacts come from the direction of the Ecliptic Pole, then it follows that the various linear arrangements of volcanoes and mountain ranges may be determined with comparative accuracy according to the lines of direction they follow. In this event we must agree that from the beginning of the creation of lands until the present time there has been a complete inversion of the Poles, taking a line first, say, from the

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* "Dawn of Mediterranean Civilisation," pp. 402–409.

† "Europa," p. 424.

Marquesas Island, New Hebrides, North Island, New Zealand and the New Zealand Ridge, the Marshall Island, the Malay Peninsula, and perhaps Sumatra, with the Sierra Nevada and Sierra Madre Mountains of North America, the North Pole at that time resting at a point somewhere between Cape Horn and the Antarctic Circle. If this be the case the group represented by Tahiti, a few degrees to the south-west and north-west, would be subsequent to those lands mentioned. In the vicissitudes of time Tahiti, like most of the Lemurian lands, has gradually moved from the north to the south. It is even probable that Tahiti and her sister lands have continuously enjoyed a soft and delicious climate, for as the Pole shifted round further north, or north-west (for roughly delineated we may take the line as from Cape Horn to the Behring Straits) Lemuria has gradually declined towards the south. It is, moreover, comparatively certain that when Tahiti lay within what now would be the icy embrace of an Arctic Circle the earth's axis, then almost true to the Pole of the Ecliptic, could scarcely boast of more than a degree or two of an arctic zone. Also the world then far less burdened with weight than at present would, in accordance with the law of gravity, complete a shorter annual orbit and so be nearer to the Sun, thus enjoying indefinitely greater warmth. Amid such conditions it can be foreseen how the greater crustaceans and mammals such as the dinosaur came into existence through volcanic agency amid atmospheric and climatic conditions which made the world of that time a vast incubator or forcing house.

193. Less fortunate than Tahiti was another land whose geological classification probably dates from the old Red Sandstone epoch. No one can study the classic descriptions of the Hyperborean Continent without recognising the fact that it represented the Atlantis of Plato, the land of Cronus or Saturn, and that it lay in the Atlantic. Disagreement may exist as to the actual location of this land, some placing it in one place others at another, but it certainly did exist traditionally in the Atlantic Ocean. To many the most important points in Plato's account of Atlantis is that it was the mother both of Egyptian and of Athenian civilisation : " For there was a time, Solon," said the priest of Sais, in Egypt, " when the city which is now Athens was first in war, and was pre-eminent for the excellence of her laws, and is said to have performed the noblest deeds, and to have had the fairest constitution of any of which tradition tells, under the face of heaven. Minerva founded your city a thousand years before ours. . . ." * He went on to say of Atlantis that " afterwards there occurred violent earthquakes and floods, and in a single day and night of rain all your warlike men in a body sunk into the earth, and the island of Atlantis in like manner disappeared and was sunk beneath the sea." †

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* Plato's " Dialogues : Timæus."

† *Ibid.*

194. It may be doubted very strongly if, accepting this statement as reasonably accurate, such a mass of land could have been permanently submerged. It is quite possible so untoward an event would eventuate in a vast tidal wave and drown great areas; even that considerably low-lying coast lands, estuaries, and so forth might be permanently submerged. There is no reasonable doubt but that the sea around the British Isles is far deeper than it was formerly, which accounts for the steady advance of the sea into places formerly dry land, for whilst here and there for certain reasons the sea has receded the erosion of the British coasts indicating increased pressure is a serious problem. Beccles Willson has recorded the significant case of the islet Scilly or Scylla, a high rock of inaccessible cliffs lying about half way between Land's End, Cornwall, and the Scilly Isles. Walls and ruins have been frequently met with on the shore of this rocky islet, whose foundations when built must have been at least 6 feet above the high-water mark, and in view of the immense size of the Atlantic breakers, were probably built much higher than that. Yet to-day these foundations lay 10 feet under the high-water mark, so that the difference of sea level is at least 16 feet and may be more.*

195. Memories of this lost Atlantean civilisation if not land were frequently evoked by the classic writers of the past. Diodorus Siculus describes

* Beccles Willson: "Lost England," p. 22.

an isle on the west of the ocean, partly mountainous and partly flat, the level watered by navigable rivers and adorned with splendid buildings, parks and gardens, and with every variety of tree. The mountains were covered with forests, wild animals abounded for the chase, the ocean was full of fish, and the temperature, climate, and salubrity made it the appropriate habitation of gods rather than of men.* It is referred to by Theopompus (*circa* 378–300 B.C.), who was noted for his accuracy, as a great land beyond the ocean, inhabited by men of gigantic size and very long-lived, where gold was more abundant than iron, and he calls it Meru or Merops †, a word seemingly cognate with the Hebrew Ereb, the west, evening, and perhaps of our word Europe. Plutarch speaks of a great land (μεγαλε ἤπειρος) situate nearest to Ogygia (which Camden and others have taken to mean Ireland), and near the isle where Saturn is held prisoner by Zeus, a reference to the underworld cult, hence suggesting Britain which was generally believed by the ancients to have been the land of Hades.‡ There are many other references by Greek and Roman writers to the former existence of a complete and highly developed civilisation in the Atlantic which was destroyed suddenly by a catastrophe of the first magnitude, burying people alive and causing among other effects a vast flood.

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* Diodorus : " Hist.," v. 19.

† Ælion, " Varia Hist.," iii., 18.

‡ Plutarch : " De Facie in Orbe Lunæ."

196. The same event is recorded in the ancient legends of the Aztecs of Mexico and other Central American peoples, as gathered by the earliest Spanish invaders. They said they had come long ago from " Aztlan," where there was a great capital (Tula, Tulan or Tollan) containing streets, palaces, pyramids, rivers, canals, and a volcano. Before the destruction of this land, which was foretold by their prophets, a series of plagues occurred almost identical with those related as happening to Pharaoh and his people. Aztlan enjoyed a beautiful and temperate climate, possessed woods and fruit, flowers and birds, streams and lakes. " In a single day all was lost," say the Aztec traditions, " even the mountains sank into the water."

196A. When Cortez captured Mexico City the Aztec Emperor Montezuma mentioned Aztlan : " Our fathers dwelt in that happy and prosperous place which they called Aztlan," he is reputed to have said, " In this place there is a great mountain in the middle of the water which is called Culhuacan." Montezuma described the charms of this favoured land as abounding in birds, game, fish, " fountains enclosed with elders, and junipers and alder trees both large and beautiful," a country of agriculture and market gardeners, where were planted " maize, red pepper, tomatoes, beans and all kinds of plants in furrows." * The Aztecs

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* H. H. Bancroft : " Native Races of the Pacific," vol. v., p. 305.

showed Aztlan in their rude drawings as a round, taper-shaped volcano with the crater turned over to suggest an eruption, and they called this mountain Culhuacan, that is Serpent Mount. The Miztecs of Mexico described Culhuacan as the " Place of Heaven," a mountain where the gods built a sumptuous palace, a masterpiece of skill and there had their " abode." Subsequently, " there came a great deluge in which many of the sons and daughters of the gods perished." *

197. The mention of these ancient traditions, only too often wrenched from their true setting and forced to do service in a situation utterly remote from the evidence, is pertinent to the subject because it was the land beyond all others destroyed and rendered uninhabitable by reason of the great catastrophe of the Drift. It could not have lain in the neighbourhood of the Canary Islands even had there been indications of a considerable land surface in such a locality, and such are entirely lacking. The ancient world thus torn apart and drowned lay in the very vortex of the storm and, as the Drift proves, it was situate in the regions of the North Atlantic. It possibly stretched on the one side to include the North Atlantic Divide of which the Azores are the sole survivors and on the other *viâ* Davis Strait and Baffin Land, embraced Canada and North America. The Goth Jornandez said that the north was the

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* H. H. Bancroft: " Native Races of the Pacific," vol. v., p. 306.

forge of mankind, and the early history of the human race, comprising our forefathers belongs not to Asia or Africa, but rather to the regions from the Baltic to Greenland, and, there is reason to believe, with Britain as the centre. The early history of man, and by " Man " is meant naturally the Aryan race, the Nordics, can only be resolved with a scientific understanding of meteorology as the key. It is futile to attempt to trace the history of the great nations of antiquity (which lead us step by step up to the present age, or should do) without any comprehension of the governing causes which have resulted in the creation of mankind, guides his primitive and patriarchal history influenced by conditions of climate and great periodical catastrophes, and causing amongst other effects enormous migrations of peoples to other parts. Wars of invasion in the long run rarely yield any permanent traces, for the conquerors become incorporated with the conquered, but the acts of God, written upon a vast and systematic scale, may teach the metaphysician something he ardently desires to learn by the lessons of volcanoes and meteors. He must read the signs aright, revise the teachings which have led to nowhere, and then perhaps he may solve the profound problem Hypatia set ages ago : " Who are we ? Why are we ? Whence came we ? "

198. If the facts and deductions advanced in this work are accepted, as in time in the main they must be, apart from the need of astronomers,

geologists, seismologists and vulcanists to revise their estimates—as they are beginning to do in the United States of America in several of these questions—weather conditions will be understood and provided against as far as is possible. If we cannot prevent earthquakes we can at least avoid building cities in the direct line of longitude from the Magnetic Pole immediately north or south of an active volcano. If we cannot prevent great storms or gales we can certainly understand their inception and thus make provision for new methods by which preparations may be put into force to avoid the loss of life and property as ensues under the present haphazard guesswork. We shall more readily understand the incidence of oil and coal-fields and know accordingly where to search for these commodities of meteor origin. Once we realise these matters we shall have solved the Riddle of the Earth.

THE END

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